Orbit

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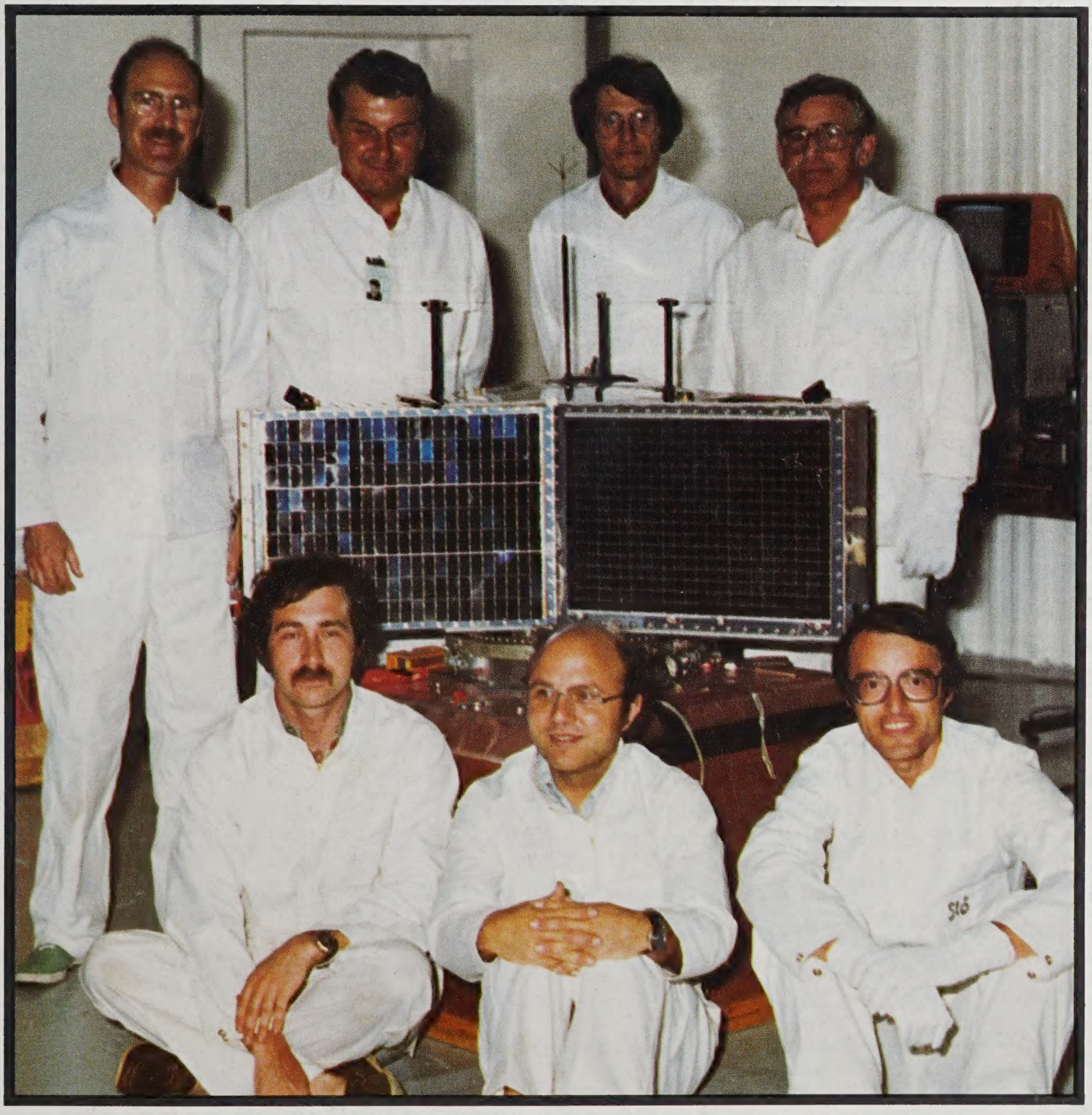

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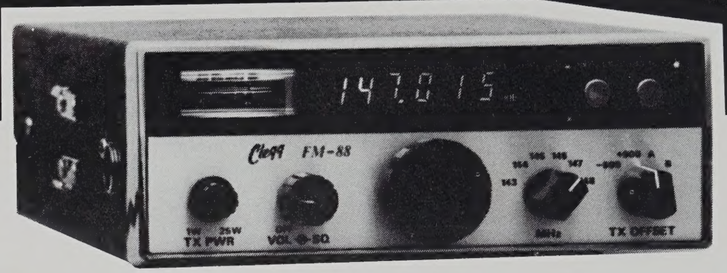

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Orbit

June/July, 1980
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Editorial

By Joe Kasser,* G3ZCZ/W3

That G3ZCZ/JA3 signature on the editorial of the last issue was no misprint. Apart from the time spent on AMSAT activities during the week your editor has to spend at least 40 hours a week of his spare time working for his employer who decided to send him to Japan for six weeks. After a brief flurry of activity spent in putting together the first issue of the magazine, your editor departed to Japan missing the integration of the Phase III satellite, the testing of the Telemetry tracking and control software, and all the fun and games involved in getting the spacecraft ready at the lab.

Arriving in Japan was like landing on another planet. The language, culture and way of doing things was different in many respects from the Western equivalent. When I first heard Japanese spoken, on the plane and at the airport it sounded like random noise, not even registering as a language.

During my stay in Japan, I did get to Tokyo twice and met several of the JAMSAT crowd including Harry Yoneida, JA1ANG and Miki Nakayama, JR1SWB. I had a number of discussions with them, mostly about AMSAT, JAMSAT and microcomputers. Miki also served as our parttime guide and took us around Tokyo. We visited the offices of *CQ Ham Radio* magazine, the offices of the Japan Amateur Radio League (JARL), and the Akihabara district of Tokyo in which lie the surplus and Amateur Radio stores. Ham equipment is roughly 60% of its stateside cost. For example, I saw ASCII encoded keyboards in cases for only $10.00. If my suitcases were not already bulging I'd have bought some of those as well. Funnily enough S-100 hardware is cheaper in the USA. Miki, Harry and all the other Japanese that I met, really went out of their way to aid and assist the foreigners in their country, and I'd like to use this page to once again convey my thanks. During the trip, I hope that I obtained some understanding of their problems, one of which is FM-QRM in the satellite downlink passbands. Many was the FM QSO that I heard on 145.90 MHz, and other frequencies between 145.85 and 146.00 MHz. Considering the fact that there are no repeaters in Japan, the band is filled with used simplex channels. I saw a copy of the Japanese domestic call book—it is thicker than both issues of the *CALLBOOK* magazine combined, and a lot of those amateurs are on two meters.

By the time that I left Japan, it was no longer a strange planet. It had turned into a charming and friendly country that in some ways I was sorry to leave. Even the language was beginning to make sense, no longer sounding like random noise. One day I hope to return.

Life Member Mailing

The cost of mailing the first issue of *ORBIT* to life members was nearly $1000. The cost of mailing the magazine to the rest of the U.S. membership was about $50. It was this cost which generated the confusion about first class mailing of the magazine. It is assumed that most life members want their donations to support AMSAT rather than the U.S. Post Office and except for special situations, would not mind receiving the magazine by second class mail, knowing that the funds thus saved would be put to good use within AMSAT. As such it is proposed to mail all issues of the magazine in envelopes at the reduced rate unless life members specifically request that theirs be mailed first class.

It Never Rains But It Pours . . .

As you may have heard and can read in the magazine, our President Perry Klein has resigned from the organization. This necessitated moving the offices just at the time of the launch. There may have been inadvertent anomalies in the actions of the organization and headquarters staff. The transition was eased by the efforts of our Office Manager Martha Saragovitz and those Washington area volunteers who helped move miscellaneous office supplies, equipment and 10 years of accumulated spacecraft telemetry data and related correspondence.

Nominations

Once again it is time for nominating candidates for election to the Board of Directors. It only takes five members to nominate somebody (or a member society). If you feel strongly about one aspect of the organization why not run for office or stand for election.

Payload Retrieval

ORBIT is a little different from the *AMSAT Newsletter*, in case you haven't noticed. We'd like some feedback from you as to the type of article you'd like to see in the magazine. As such we've instigated a new feature in which your vote will tell us which articles you liked best. Please also let us know what kind of articles you'd like.

The AMSAT Board of Directors have decided upon the following policy on providing honorariums to authors published in the magazine. The readers will be called upon to vote for the best article in each issue in both of two categories. One category is "technical", the other "general interest". You the reader choose by returning the Payload Retrieval coupon in each issue. If you feel that the best article meets the requirements of both categories, so be it. The author of the article voted "best of the issue" in each category in each issue will be awarded an honorarium of $50.00. At the end of the year, you, the reader will be asked to vote for the "best of the year" articles from amongst the issue best and a suitable prize will be awarded.

Harry Yoneida, JA1ANG, Fay Kasser and Miki Yasu Nakayama, JR1SWB, outside the Meji Shrine in Tokyo.

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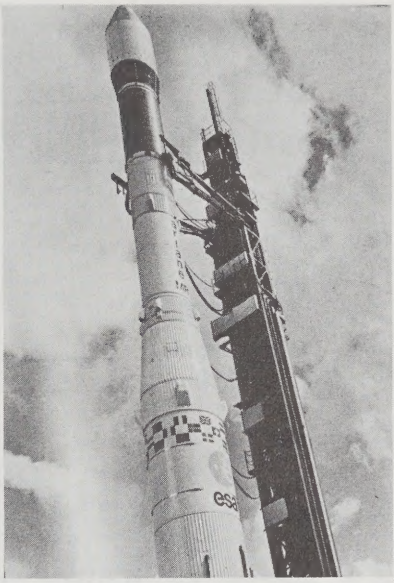
PHASE IIIA SPACECRAFT LOST!



By Tom Clark,* W3IWI and Joe Kasser,** G3ZCZ

Friday, May 23, 1980 will be long remembered by all active satellite users. The potential was there, the promise was known, but..... When the launch window opened at 1130 U.T.C. The AMSAT Launch Information Networks (ALINS) was in full bloom. Radio amateurs all over the world listened to the voice of Tom Clark, W3IWI, describing the status of the launch of the AMSAT-Phase IIIA satellite. Almost three hours later, seconds before the launch window closed, the Ariane LO2 rocket majestically rose from the launch pad. A few moments later, the first stage malfunctioned and the vehicle exploded.

After the launch failure, all of us who were involved in the planning, fabrication, testing and operations aspects of Phase IIIA felt a deep loss, not unlike that caused by the death of a family member. To many of the users who had only heard of the promises of the Phase III satellite, the loss was probably like a stillbirth, a miscarriage. But to many of us who had lived, slept, eaten and breathed Phase III for upwards of five years, please realize that the satellite was much, much more. Jan King, W3GEY, stated, "the community will *never* know what they lost today" while choking away a tear of remorse. The Phase IIIA satellite represented the zenith, the culmination, the pinnacle of five years of hard work. To date, we know that more than 30 man-years have gone into the program. The AMSAT budget was $150,000 plus countless (don't even ask how much) donations from other sources. Many of the hard-core workers have invested their own personal resources, never thinking of being compensated for hundreds of dollars spent on telephone calls, postage, time, parts, etc. Yes the loss was deeply felt by the community, but even more deeply felt by those few who really had "paid their dues."

Following numerous discussions with members of this hard-core group, and on hearing the expressions of sympathy and promises of support coming from the amateur community, the consensus seems to be summarized as follows:

> *What we lost on Black Friday was sheet metal, solar cells, batteries, transistors, a lot of sleep and a major portion of our lives for the last few years. What we gained over those same years was knowledge; knowledge that we could make a complicated spacecraft. Knowledge in areas of aerospace technology that none of us had before. Knowledge that we could work as a team, despite national boundaries, differences in our cultures, lifestyles and personalities. Knowledge that, from within the ranks of Amateur Radio, we could draw upon enough resources to attempt a project with a complexity rivaling commercial satellite endeavors funded at levels of tens of millions of dollars. The knowledge is still intact. We even had the forethought to purchase a duplicate set of sheet metal that constitutes the spaceframe. We have a second set of solar panels, batteries and sensors. We have on hand the documentation and artwork necessary to replicate all the printed-circuit boards. We have in place and ready to go a network of ground telecommand stations.*

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*President, AMSAT
**Editor, *ORBIT* Magazine

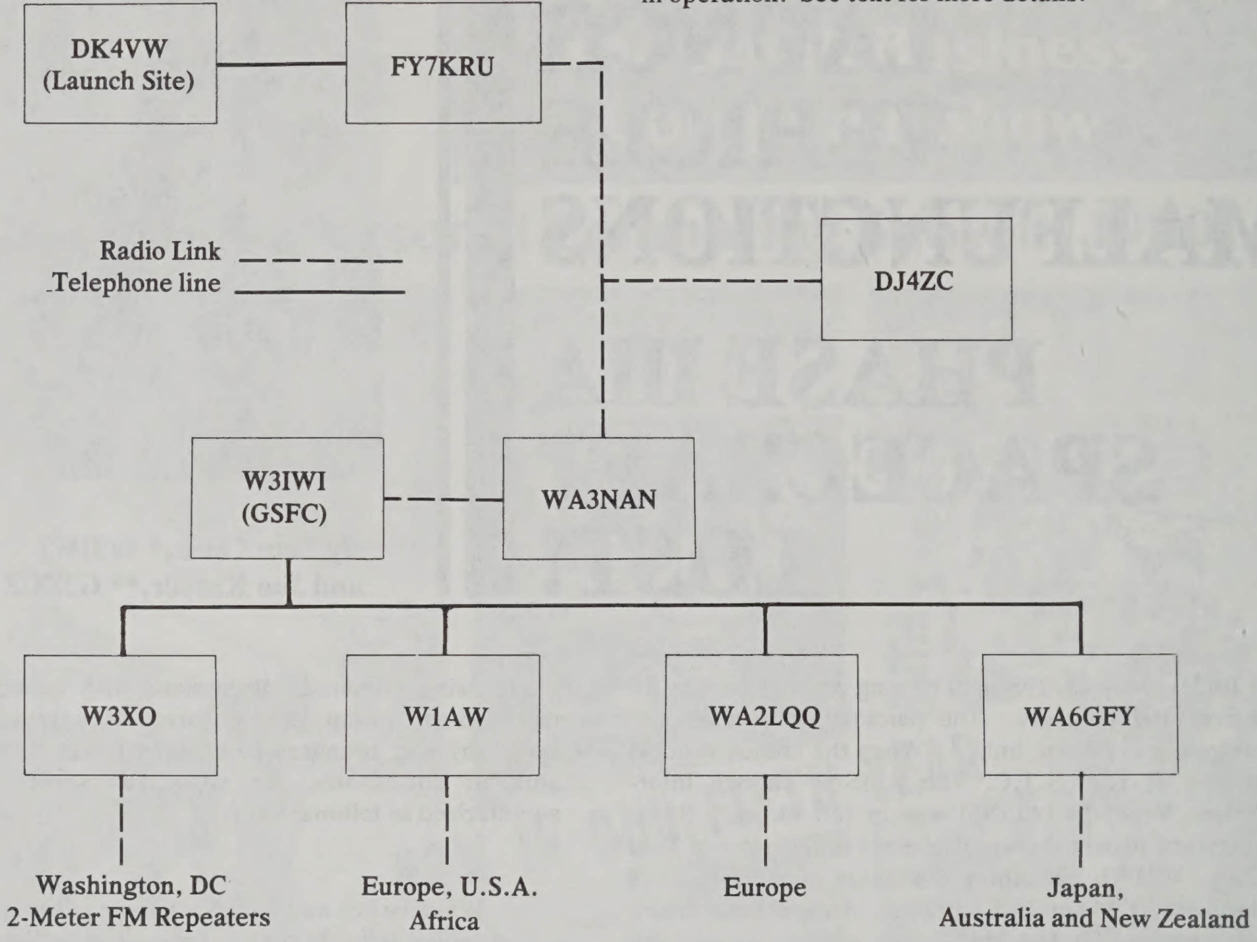


Fig.1 - ALINS (AMSAT Launch Information Networks) in operation. See text for more details.

AMSAT is investigating launch opportunities, but that is a time consuming process. Given a little luck, a Phase IIIB spacecraft could be on the launch pad in two to three years. Your support is needed in that time frame. The launch was not insured because insurance is as yet unavailable for the Ariane launch vehicle. AMSAT has thus had to bear the full cost of the mishap. Funding for your organization was planned on the basis of a near-zero bank balance at launch time, budgeting that new memberships attracted by an operational satellite would provide further funding following the launch. Money is needed for the day to day operations and for support of the on-going hardware programs such as the Canadian Synchronous transponder project and the British Scientific satellite due for launch in late 1981. We knew that May 1980 would be a month of change for the organization, what with the office relocation and the launch. We did not however, anticipate the nature of the change.

From our point of view, the Phase III program is still active. The vision of W3GEY and DJ4ZC pointed out the potential of the Phase III program. Their visions were expanded by others in all directions. Software and hardware were developed. A world-wide AMSAT Telemetry Tracking and Control Network was established, and still exists. The potential of the satellite for public service, computer communications networks, emergency relief, education and a host of other things was recognized, developed and published. The Spacecraft itself was integrated, tested and loaded aboard the launch vehicle in a timely manner. AMSAT had done all it could, and on the 23rd of May, we were ready.

At the launch center in Kourou, Ulrich, DK4VW in the block house was in telephone contact with the Radio Amateur Club Station FY7KRU. FY7KRU was in contact with DJ4ZC in Marburg, Germany and WA3NAN at the NASA Goddard Space Flight Center (GSFC) near Washington, DC. Amongst those present at Kourou were FY7AS, FY7BC, FY7BK, F6ADU, F8LC, F8ZS, F9CE and Conrad Mueller. Operating at WA3NAN were K1HTV and K9LF. WA3NAN used two-meter fm simplex to communicate with the GSFC control room. K9LF translated the French into English. Amongst those active or observing at the GSFC Control Room were W3GEY, W3IWI, W3PJM, W3PK, W4PUJ, W4RI, WB4NFB, WB5MMB, WB7ADU, G3ZCZ, LU9HBG and Martha. W3IWI held down the position of launch information officer. He was in direct telephone contact with W1AW (WB1EYI and K1JX), WA2LQQ, W3XO and WA6GFY (W6XN, W6TWU, N6OO) who relayed the launch data around the world. Other stations around the world relayed the activity on vhf/uhf for local coverage.

There were many holds during the launch window. These were associated with apparent equipment malfunctions or a local cloudburst at the launch site. Jan, W3GEY requested and obtained several telemetry readings of the battery voltage, worrying about babysitting his progeny right through the launch window. Finally, with seconds to go before the close of the window, the countdown reached zero at 14 hours, 29 minutes and 40 seconds. Liftoff was 2.3 seconds later.

The AMSAT network link via WA3NAN and FY7KRU provided better information flow than the NASA/ESA link. In fact at times the amateurs were able to provide NASA with information concerning the "holds" before the ESA/NASA link did.

The progress of the flight was announced over ESA/NASA link. At 14:32:57 we heard an announcement to the effect that both launch vehicle transponders were off. The joking and verbal interplay in the control center ceased abruptly. This was soon followed by the words "non-nominal flying....problem in one engine.... the rocket is going down.... Kourou radar still tracking" and at 14:36:38 we heard the words "splashdown."

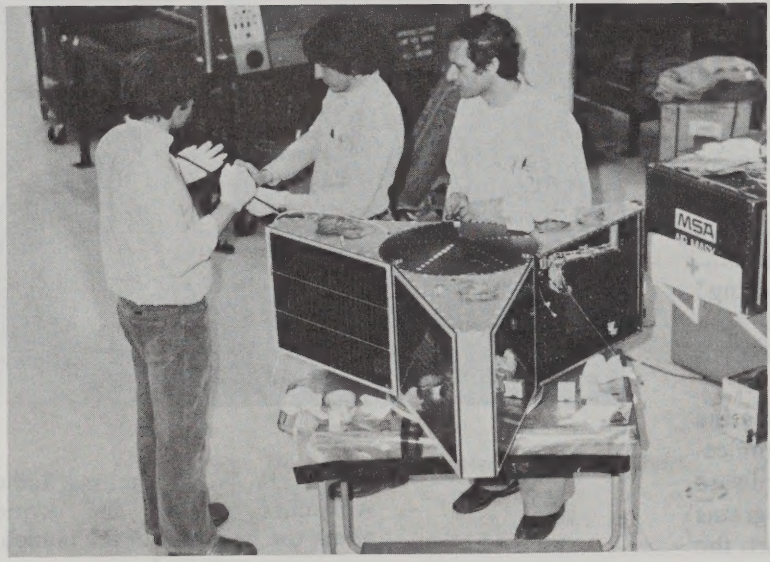
It was the first time that a satellite in the OSCAR series had failed to reach orbit.

AMSAT today stands at a crossroads. We have the knowledge and technology to build more communications satellites. We have a lot of the critical hardware and software. We have on going construction programs in Canada, England and Japan. With your support, the failure of the Phase IIIA launch will prove to be only a temporary setback to the Radio Amateur Satellite Program.

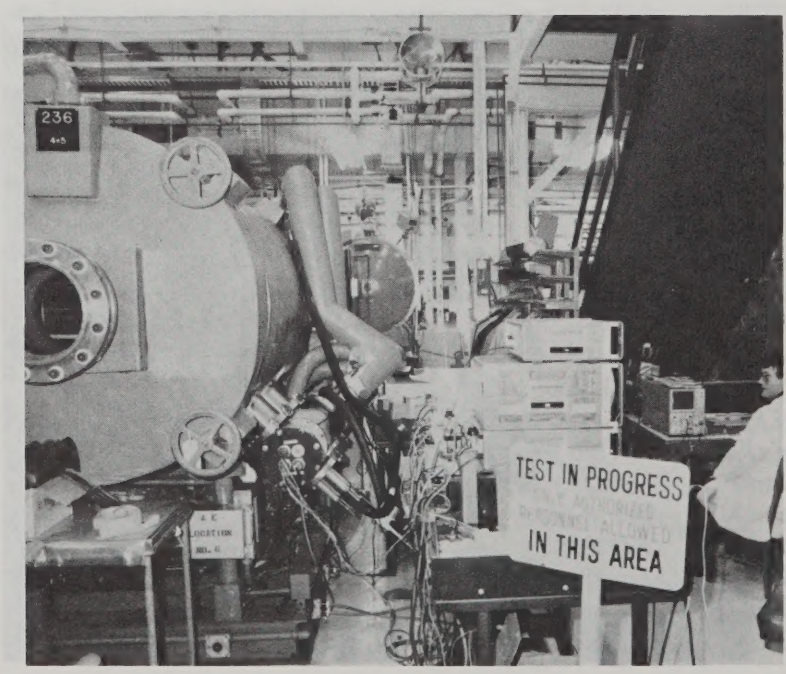
Tom Clark, W3IWI, telling Radio Amateurs around the world about the progress of the launch.

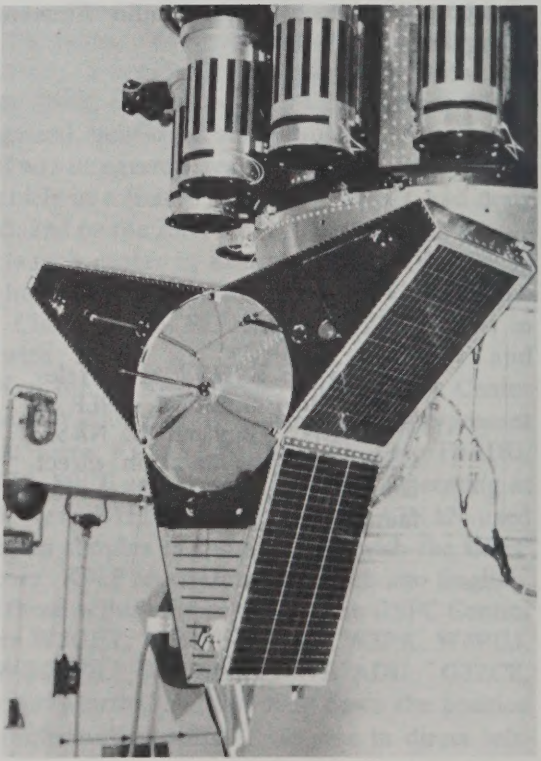
Rich Zwirko, K1HTV, at the telephone and Bill Brown, K9LF at WA3NAN. They put the NASA GSFC Control Room in direct contact with FY7KRU at the launch site.

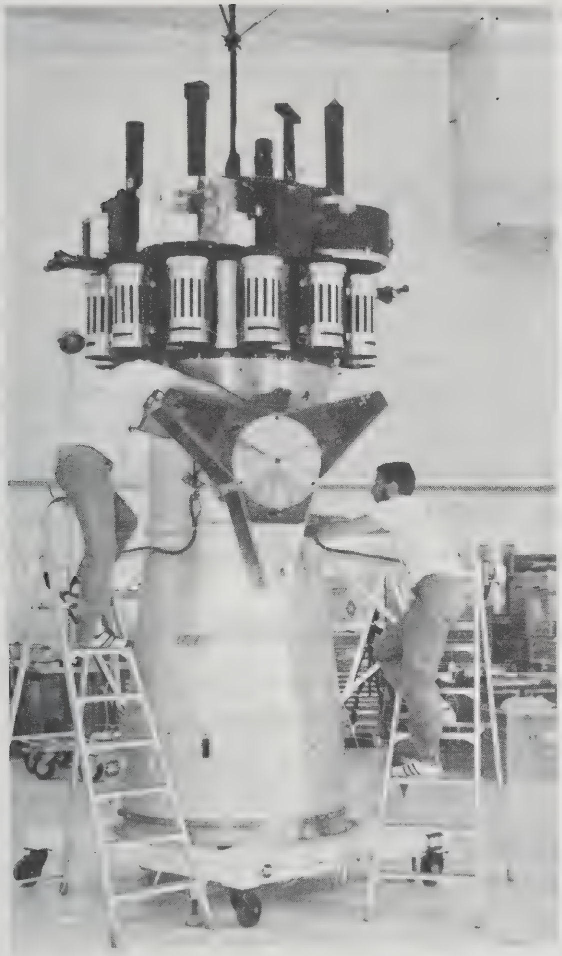
Above: WA6GFY Antenna System.
Below: Our Phase III Spacecraft ready to go.



Shown above and below is the Phase IIIA Satellite under test.







Above: Jan, W3GEY, before the final countdown.
Below: Steve, WB1EYI operating at W1AW.

The AMSAT Phase III Satellite

By Joe Kasser,* G3ZCZ

Part I of this article appeared in the March issue. Here, Part II provides the remainder of the necessary instructions for a full understanding of Phase III Satellite operations.

The Launch

The initial launch is planned to put the satellite into an immediate orbit with an apogee of 36,000 km, and a perigee of 200 km at an inclination of 17.5 degrees. While in this orbit, the satellite will not be available for communications use and the transponders will be turned off. Since the attitude of the satellite may not be stable, the satellite will be transmitting beacon data via its omni antenna. It is expected that the downlink signals will be weak at this time.

Since signals from the satellite will be weak, and the transponder will be switched off except when ranging is going on to determine the orbital parameters, users are requested not to attempt to access the spacecraft at this time.

The AMSAT telemetry tracking and control network stations will assure that the satellite stabilizes correctly and determine its precise orbit. Then about one to three weeks after launch, the apogee kick motor will be fired to initiate a plane change operation, which will also raise the perigee of the orbit to about 1500 km. These orbits are shown in Fig. 6. There will be a small residual drift in the final orbit that will cause the latitude of the apogee to slowly change, increasing over a period of years to around 57 degrees then slowly decreasing slowly over the years. This drift will tend to complicate long term graphical orbit prediction techniques.

When this orbit has been achieved and the satellite has stabilized, AMSAT will make it available for general use, reminding all communicators about the voluntary band plan.

Orbital information will be disseminated via the regular channels. The Phase III orbits will be numbered from perigee point rather than from the equatorial crossing location as was used with the Phase II satellites.

Receiving Equipment

Signals from the satellite are expected to be 1½S-units weaker than the same signals as heard through the AMSAT—OSCAR 7 Mode-B transponder.

The downlink signals leave the satellite as left-hand circularly polarized (LHCP). Previous published information specified that the downlink would be right-hand circular polarization, however during the Spacecraft checkout prior to launch it was discovered that the antenna was radiating LHCP signals. It appears that the Spacecraft is not large enough to act as a ground plane so that some of the basic assumptions used in the design of the antenna were wrong, and there was not enough time left before the launch to remake and requalify the antenna wiring harness. Thus the downlink is LHCP and AMSAT apologizes for any inconvenience to the user community.

A downlink receiver at 145.90 MHz with a low noise front end will thus be required. It is advisable to keep the signal lines at rf as short as possible. In fact since the Spacecraft will spend most of the time high in the sky, antennas at or close to ground level will be sufficient, just as long as they have a clear shot at the satellite. Note that buildings and even trees attenuate the signal. If you have to use an antenna in the sky, think about putting a preamp or better still, a converter right at the antenna and running i-f signals down that long cable.

Any reasonable two-meter SSB/CW station should be adequate, if elevation controlability is added to the antenna system. If you are presently receiving AMSAT-OSCAR 7 with strong signals, you may need to do nothing to your receiving system, or just change the antenna to receive LHCP signals.

*Editor, *ORBIT* Magazine.

The General Beacon

Data is transmitted on the general beacon using Morse Code or 170 Hz shift FSK RTTY at 60 words per minute. The RTTY data should be printable on machines using 45.5 baud or 50 bauds because, although transmitted at 50 bauds, the stop bit is extended to two bits instead of the more usual 1½ bits. The availability of an on-board microcomputer allows the beacon to be used for more than simple telemetry or code store purposes. It is now possible to carry orbital data and bulletins of general interest on the beacon as well as the telemetry. The proposed hourly format for the beacon transmissions is shown in Fig. 7. The telemetry will consist of ten channels with descriptions in English and the values in engineering units. The on-board computer will perform the conversions that were not done on previous satellites.

The Engineering Beacon

Telemetry is being transmitted on the Engineering beacon at a rate of 400 bits/second using phase shift keyed (PSK) modulation. Studies of the link capability showed that the optimal data rate was around 500 bits per second. Since the Spacecraft on-board computer already contained a 20 ms clock for housekeeping and RTTY purposes, the 400 b/s data rate was chosen so as to simplify the on-board hardware. The use of uncoded PSK allows those signals to fit in a two-kilohertz bandwidth so that conventional SSB receivers may be used in ground stations.

There are two basic design ways of demodulating these PSK signals as shown in Fig. 8. The audio technique was discribed by Karl Meinzer, DJ4ZC in the June, 1979 issue of the *AMSAT Newsletter.* This kind of outboard demodulator is analogous to the terminal unit technique used for RTTY reception. The receiver audio is fed into the unit, and if it is correctly tuned, it will output serial non-return-to-zero (NRZ) data. This approach, however, does suffer from several undesirable characteristics such as spurious lockups. An alternative approach, developed by Tom Clark, W3IWI, and John DuBois, W1HDX, uses an i-f demodulation technique, which offers significant advantages over a-f demodulation techniques, but requires a 455-kHz output from the receiver. This technique, and practical circuits will be described in a future issue of *ORBIT.*

The AMSAT Telemetry Tracking and Command Stations use the i-f demodulation technique for receiving the Phase IIIA satellite engineering beacon data. A two meter converter feeds a converted 27-MHz transceiver chassis of the kind available at very low cost from any of several outlets in the U.S.A. The 455-kHz signal is extracted before the diode detector and is fed to the i-f dem. board where recovered serial data is fed to the bit regenerator board. The output from this board is a serial 400 bit/second data stream.

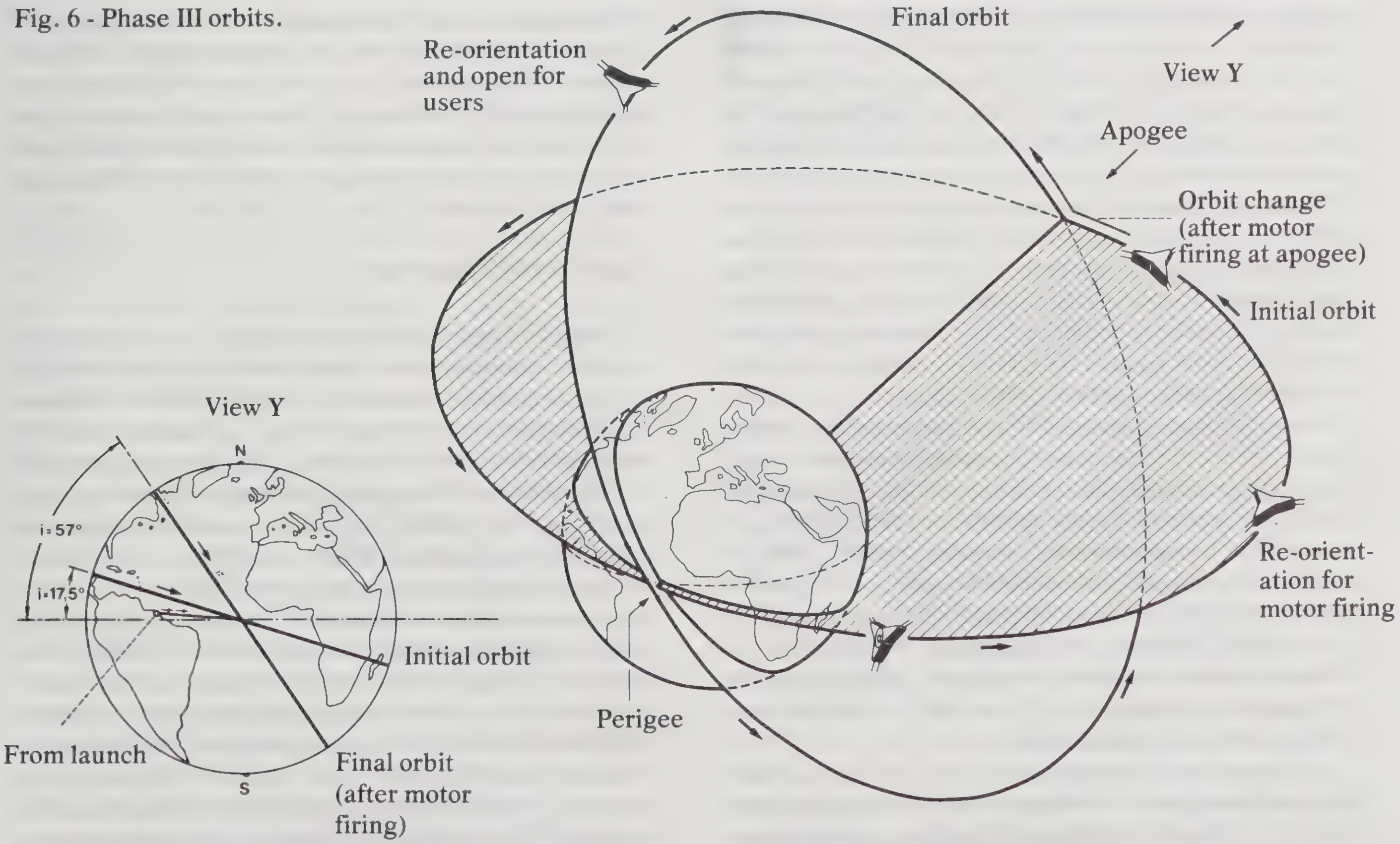


Fig. 6 - Phase III orbits.
Final orbit
Re-orientation and open for users
View Y
Apogee
Orbit change (after motor firing at apogee)
Initial orbit
Re-orientation for motor firing
Perigee
View Y
N
S
i=57°
i=17,5°
Initial orbit
From launch
Final orbit (after motor firing)

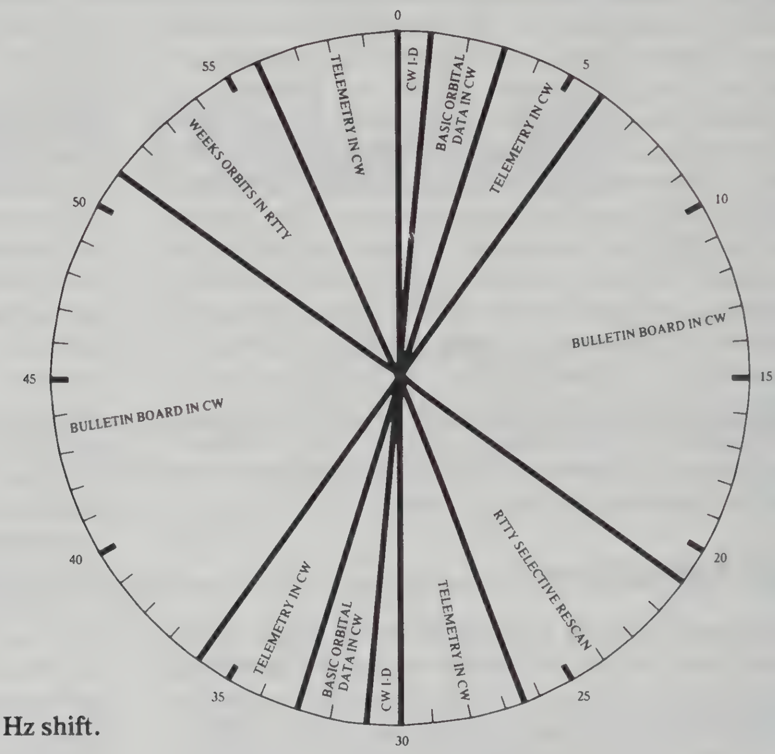


Fig. 7 - General beacon hourly format.

Notes:
CW transmissions will be sent at 15 wpm.
RTTY transmissions will be at 60 wpm,
Baudot (five level) code and will be FSK 170 Hz shift.

The satellite data is transmitted MSB first. This is *opposite* to the established serial data convention. Thus any microcomputer or TV terminal containing a USRT and a 400 bits/second clock can be used to display (and process) data remembering it is bit reversed. AMSAT developed a telemetry-ranging card (TRUMP) for S-100 bus computers for use by the tracking and command stations as part of the AMSAT-GOLEM-80 Project. This card is available to members who have S-100 bus systems and who have the technical expertise to use it.

The actual data is transmitted in blocks of 512 bytes (4096 bits) each byte containing eight bits. Synchronous data formats generally contain complete data blocks even if the message is smaller than a complete block. Under these conditions 'fill' characters are used to make up the block. The fill character used in the engineering beacon is 01010000 or 50 hex.

Four bytes are used to indicate the start of a block. These bytes are used to synchronize the receiver to the data to alert it to the fact that a new block is beginning. This sync-vector block is then followed by 512 bytes of data. This technique allows the sync-vector to be decoded by hardware instead of software and is used in the old AMSAT-IPS-tape format interface cards. The sync-vector contains the sequence 39, 19, ED, 30. Following the transmission of a block of data, a series of 50's are transmitted for 2.5 seconds before the next sync-vector and block of data.

As a rule, the contents of a data block will be clear text consisting of ASCII characters. These raw characters will thus be readable without any additional processing. When ranging or commanding is being performed, ranging signals or command acknowledgements will take the place of the regular telemetry.

The data will include 64 channels of telemetry. The format as seen on a video display of 64 characters by 16 lines is as follows. The header, identification, time and status information will be transmitted first, followed by four lines of 16 data words. These words comprise the telemetry and are transmitted sequentially starting at word zero and proceeding at a rate of 16 words a line until word 3F (64) .

Transmitting Equipment

Transmitting equipment necessary to communicate via this satellite is essentially similar to that used to communicate by means of the AMSAT-OSCAR 7 spacecraft Mode-B transponder. That is, an uplink SSB/CW transmitter on the 70-cm band and a downlink receiver at 145.90 MHz. The uplink passband is, however, centered at 435.2 MHz. Since the satellite height at apogee is much greater than that of AMSAT-OSCAR 7, there will be a greater path loss and as such, greater transmitter power output will be needed. Unfortunately due to the shape of the antenna radiation pattern, the path loss is expected to remain constant as the Spacecraft falls away from apogee and gets closer to earth. When the satellite is close to perigee, the antenna is pointing away from the earth and the on-board computer will switch the transponder to the omnidirectional antenna. This means that signals will be approximately

1½ S-Unit weaker than their corresponding received strength in Mode-B. Thus, if you are currently getting 5/9 reports on Mode-B, you may not need to do anything to your transmitting system. If not, or if you still insist on 5/9 reports, you will have to add about 10 dB of gain to your uplink. This may be achieved by a larger antenna, or an amplifier, or a combination of both. In any case, do not exceed the pre-launch estimated value of 800-1000 watts radiated power, or better yet, your signal, as you receive it, should be the *second* strongest in the passband.

In passing it may be worthwhile noting that all previous pre-launch estimates of necessary uplink power required to communicate via AMSAT-OSCAR transponders have been wrong. Mode-A transponders were quoted at 300-500 watts EIRP and Mode-B was quoted at 100 watts effective radiated power.

Communicating Through the Satellite

All communications through the transponder passband will be affected by the following three characteristics of the ground-to-Spacecraft path:

1) delay time
2) spin modulation
3) doppler effect

Delay Time

There will be a noticeable time delay on your received signals when the Spacecraft is near apogee. This is due to the fact that the speed of light is not infinite, and signals will take about 0.25 seconds for the round trip up to the satellite and back. Thus when trying to find your own signal, set the transmitter and tune around the calculated receiver frequency. Your uplink is going to be within the passband of 435.277 MHz to 435.153 MHz in accordance with the band plan shown in Fig. 4. The center of the passband is in the mixed mode area at an uplink frequency of 435.215 MHz corresponding to a downlink of 145.90 MHz. Since the passband is split into three operating modes, it may be worthwhile for beginners to attempt access at 435.215 MHz and listen for themselves around 145.90 MHz. Then when their signal is heard, the uplink frequency can be adjusted so as to move the downlink into the wanted sub-band remembering that the passband is inverted. This means that CW stations should tune the transmitter higher in frequency and their receiver lower in frequency. Set the transmitter to the desired frequency; set the receiver to the corresponding downlink frequency and only then transmit a signal and find yourself. You can then adjust frequency to zero beat someone else. In this manner you will not generate unnecessary QRM to other users, or receive too much QRM from others doing the same thing. The communications passband frequencies are shown in Fig. 9 .

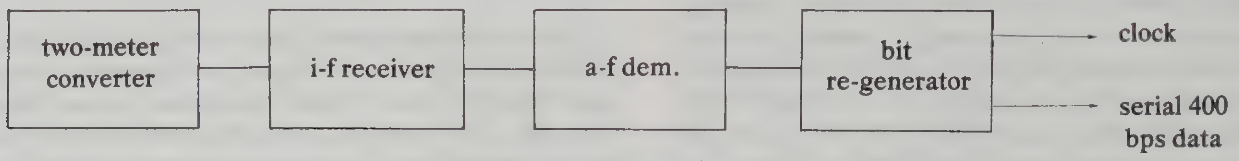
Spin Modulation

Spin modulation occurs because the AMSAT Phase III satellite is stabilized in space by intentionally being spun about its axis. Since the antenna system is not 'de-spun', it too revolves at the spin rate, and any nulls or departures from a circular coverage pattern are manifested as amplitude modulation on the received transmissions. It is estimated that the spin rate would be on the order of one to three Hertz, and that the maximum depth of the a-m effect would be not greater than ten dB.

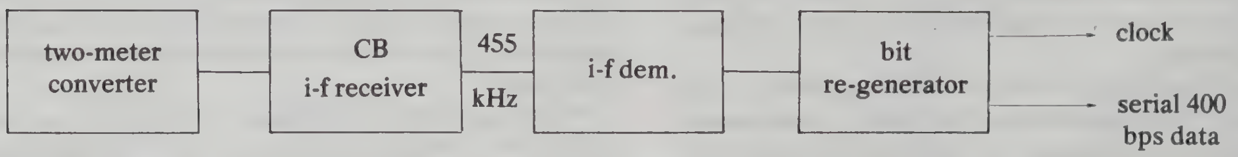
W7FF and N7WS put together a lab test set-up consisting of a PIN diode modulator, a function generator for the modulating frequency, and W7FF's homebrew high-performance ten-meter amateur receiver. The PIN diode modulator was inserted in series with the antenna input to the receiver and driven by the function generator at several different frequencies. Three attenuation levels corresponding to three, six and ten dB modulation depths were obtained by varying the diode biasing, and the calibration was done using an oscilloscope. A question arose as to whether modulating *both* the received signal and the accompanying noise was the best simulation of real on-the-air conditions, or would modulating just the signal only and controlling a constant level of noise fed into the receiver be better. Obviously the noise accompanying the signal being transmitted from the satellite would be modulated, while the noise added to the signal at the receiving location would not. After some consideration, they decided that the true picture would probably be somewhere in between the two cases outlined above, so they simulated it both ways.

The first test utilized SSB voice signals received off the air on ten meters having modulation applied to the signal plus noise, as received. The second test utilized CW Morse signals was performed in the lab where a noise generator was used to insert controlled levels of noise into the receiver after the modulator. In this setup the received CW Morse signals were generated locally for better control. In both SSB and CW Morse demonstrations, extremes of signal strength and signal-to-noise ratios of one S-Unit above the noise level to S-9 on SSB, and $S/N = 1$ to $S/N = 50$ on the CW signals were used. On the weak signal tests the receiver agc was disabled and maximum gain was used.

The conclusion they reached was that for modulation depths not greatly exceeding ten dB, there should be no significant degradation to the readability of SSB voice or CW Morse signals as a result of spin modulation effects between approximately 1.0 and 3.5 Hertz occurring on downlink signals from the AMSAT-Phase III satellite. This may not be true of other forms of modulation such as RTTY where the error rate could possibly be affected, but the received voice and CW signals were Q5 even under weak-signal noisy conditions. The modulation could be clearly heard pumping the receiver agc, and is somewhat similar to earlier days on



A-f Demodulation Technique



I-f Demodulation Technique

Fig. 8 - Demodulation Techniques

two meters when, with most hams using a-m, aircraft flutter was quite a common occurrence on the signals. However, if the real spin modulation is not significantly greater than the modulation depths used in these tests, it is believed that little difficulty will be experienced by operators utilizing fairly good communications equipment.

The Doppler Effect

This was briefly discussed in Part-I. Fig. 5 shows the effect is minimal except when the Spacecraft is close to preigee. Thus, as far as the band plan is concerned, the doppler effect can be ignored for most of the orbit. At perigee, where the effect is similar to that experienced by Phase II communicators, the uplink frequency will have to be adjusted to keep the downlink within the passband. Since the delay time will be minimal at perigee, and the Spacecraft will be using the omni antenna, operating through a Phase III satellite at perigee ought to be almost the same as operating through a Phase II satellite.

Summary

These two articles have covered the user requirements for making the maximum use of the AMSAT-Phase III satellite, to be known as AMSAT-9 after a successful launch. The Spacecraft is another example of international cooperation in Amateur Radio, having been integrated from modules built in the Federal Republic of Germany, the Peoples Republic of Hungary and the United States of America. In support of this satellite AMSAT has set up a Telemetry Tracking and Command Network of stations in the Federal Republic of Germany, New Zealand, The United Kingdom, United States and in Canada.

With the successful launch of this Spacecraft, the Amateur Satellite Service leaves the experimental phase and enters into the operational era.

Acknowledgements

The author would like to thank the following radio amateurs who supplied information used in this article: DJ4ZC, K1HTV, W1HDX, W3GEY, W3IWI, N7WS, and W7FF. Note that the contributions of K1YCM should have been acknowledged instead of K1YZM in Part I.

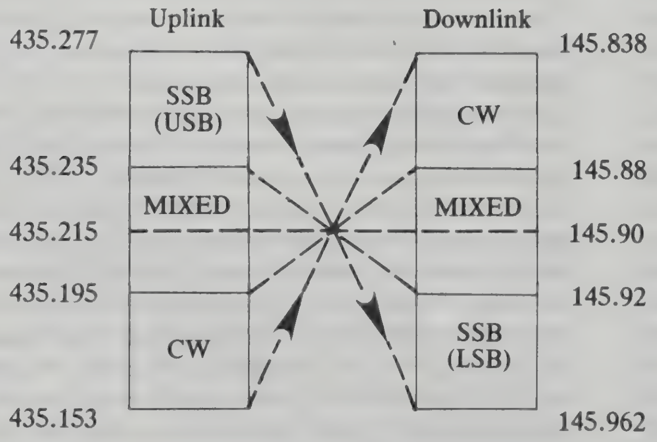


Fig. 9 - Communications Passband.

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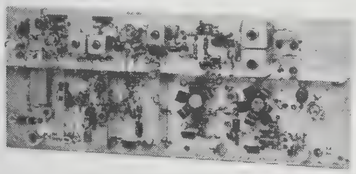

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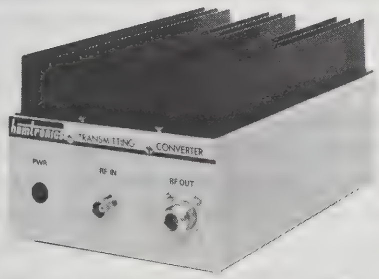

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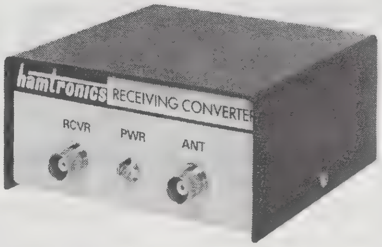

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CA144	144-146	28-30
CA145	145-147–or– 144-144.4	28-30 27-27.4 (CB)
CA146	146-148	28-30
CA220	220-222	28-30
CA220-2	220-224	144-148
CA110	Any 2MHz of Aircraft Band	26-28 or 28-30
CA432-2	432-434	28-30
CA432-5	435-437	28-30
CA432-4	432-436	144-148

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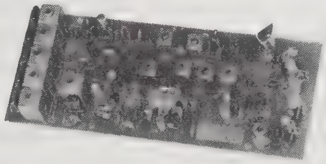

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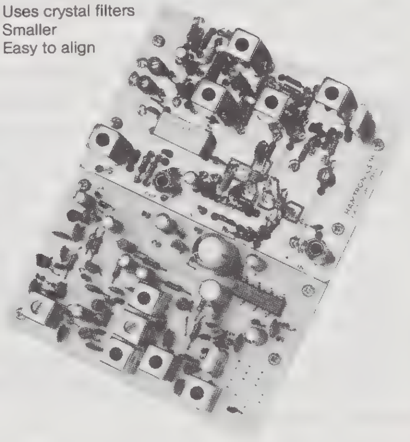

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Satellite DX & Propagation

By Pat Gowen,* G3IOR

With the current limelight being taken by the incredible, yet far simpler, DX communication opportunities possible with the forthcoming AMSAT-OSCAR-9 spacecraft, it might be thought opportune to survey some of the achievements by way of extended and rare contacts still being made by the Phase II satellites, AMSAT-OSCAR's 7 and 8.

Naturally, during the quiet sun years, the main source of DX and use of the ten-meter band was through the employment of the OSCAR's in their 'A' modes, and vast numbers of Countries, Zones, W, VE and VK call areas have been worked by this means, depending on the location of the user ground station. Undoubtedly, the presence of the Mode 'A' downlink has contributed to the consolidation of the high end of the ten-meter band for the amateur, and kept at bay much of the military and commercial intrusion that would have otherwise occurred by little use of that part of the spectrum.

With the rise of the solar cycle, a new set of conditions now apply to the two-to-ten mode, providing a source of much interest to DX'ers, students of propagation, and exploiters of unusual and lesser known communications paths. The 145-MHz uplink suffers very high attenuation over daylight paths to the satellite, often greater than 10 dB, and is subject to considerable levels of rapid fading. On the plus side, signals may often be placed into the satellite when it is up to six minutes sub-horizon, by scatter and refraction techniques via the F1 layer. Again, on the negative side, the dense plasma from the sun following solar flares have given rise to a much increased drag factor, making long term orbit predictions very difficult, particularly for the lower orbiting OSCAR-8 spacecraft. Furthermore, the greatly increased population of the ten-meter band has led to migration to the high frequency end, stations often employ the downlink band for terrestrial QSO's.

Perhaps the most exciting phenomena is that of the extreme sub-horizon signals clearly audible from both the beacon and the transponder, often antipodal, and still clearly audible even when terrestrial communication over the same path is quite impossible. From G3IOR, regular signals have been heard from many JA stations between eight to 20 minutes prior to true AOS, and many W6 stations have been heard from eight to 35 minutes after the official LOS. It has to be recorded that it is rare to be able to access the satellite at these same times, however, good contacts have been made by awaiting AOS from a station after ones own LOS, and awaiting a report on the same downlink frequency. Although not counting as Satellite QSO's, and having to equate with ones conscience about putting a terrestrial signal in the downlink band, excellent QSO's have been made by listening to the other station off A-O-8 or A-O-7, and replying on the same ten-meter downlink frequency direct at low power. I have worked VE5XU by this method many times, and once even when the A-O-7 satellite was over the Aleutian Islands, going out of even Gordon's range. N6DD and W6DWN have been worked via both OSCAR-7 and OSCAR-8, once when the satellite was almost over French Oceania, with perfect copy, and the reverse was accomplished with the North America stations on 29.440 MHz direct when they were getting good copy of G3IOR (and other European stations) while the satellites were within the Europe access area.

During the period that the 50 MHz band was open between North America and Europe, the satellite downlink signals resulting from the two-meter uplink were auroral in quality, with a marked tonal degredation to 'Tone A', accompanied by a spread multi-doppler effect. GM4IHJ and G3IOR noted that the spread of the transponder signal was far greater than that of the ten-meter beacon alone, and was unusual in that often the signal split, resulting in two return signals being

---

*Address given at the end of this article.

TABLE I - OSCAR Listing

Station	Continents	Countries	Stations	Modes	Best DX	QRB	Points Total
G6RH	5	92 (88)	2189	A, B	PY7APS	9,200 Km	27,740
G3IOR	5	114 (108)	2000	A, B, J	W6CG	9,570 Km	26,950
OK3AU	4	98 (?)	1721	A, B, J	ZE7JX	?	23,110
AA6XI	5	18 (?)	485	A, B	JA8DXB	?	7,100

about 400 Hz apart, with the effected signal units appearing just before and continuing until just after the purer expected return. This showed clearly that a dual path was present, one direct (or at least, direct within reason) and another, forming a gradient ellipse, producing a greater elongation of path, hence the effect produced. GM4IHJ evidenced similar happenings on Mode-B and even Mode-J, which showed that communication possibilities existed close to that enabling North America to Europe QSO's on two, and possibly even 70 cm!. John pointed out that if we take the effective scatter propogation frequency as being about five times that of the true ionospheric return reflected (or should we now say refracted?) frequency, two stations with reasonable equipment and antennas stood a good chance of making contact at these times. WA3NAN further pointed out that Radar measurements were showing an enormous extension of the auroral ova, with a dense ion count. It would appear that the elevating sunspot maxima with the high 'X' flare production was giving rise to extremely high ionization levels, focussing into earth's magnetic poles, producing an effective slant ionosphere zone that could be employed to give high MUF propagation to Canada and Northern USA.

If we couple this with the fact that the preferential six-meter path from G to North America was not to W5 as one might expect, with the higher sun angle and longer period of Fall equinoxial sunlight, but to W8 and 9 (over 60% of all contacts on 50 MHz to 28.885 MHz crossband) followed in order of district numbers worked by W0, 1, 5, 2, 3, 7, 6, then 4 with only three percent of contacts made, we have further evidence of this. Truly, our OSCAR satellites are a most marvelous tool for propagational information, as they also give us warning of E, aurorae, tropo, MUF, etc., as a remarkable radio 'barometer'.

N6DD and G3IOR are conducting a series of tests when OSCAR-7 and OSCAR-8 are in tandem, by Dennis listening for OSCAR-7 when it is within uplink range of the UK, and your scribe listening for Dennis on OSCAR-8 when it is in his range. We hope that by the time you read this, that some SDX two-satellite common-mode mutual sub-horizon QSO's will have been made, and give rise to a new method of exploiting the satellites.

Many stations are now in the DXCC 'nineties' on OSCAR, with just a few more QSO's (and in some cases QSL's) needed to make the magic century. G6RH, Bob, is such a case, who has now worked 2189 different stations, in 92 countries on five continents, all on Mode-A, with 88 confirmed to date. Bob has also worked 36 of the United States, nine call areas, and all eight Canadian call areas by his dedication as a most consistent OSCAR operator. We would like to hear from other stations around the world, and for the sake of mutual interest, rather than that of competition, run a ladder of

TABLE II - Rare Countries Listing

Station	Usual Frequency	Mode	Remarks
UL7DD	A 29.430 B 145.935	CW only	Good signal when Eu QRO is QRT
9G1DY	A 29.450 B 145.950	SSB only	Ditto
4U1UN	A 29.425 '8' only	QRQ CW	Mainly active Thursdays
TU2IT	A 29.450 B 145.950	SSB only	Excellent signal, and good RX
OX3AF	A 29.445	CW	Good signal
UL7GBD	A 29.430	CW only	Good signal and RX
UA9YB	A 29.440	CW only	. . . .
OE3PIW	B 145.945	SSB only	
HG8CY	B 145.930	CW only	
UQ2AN	A 29.440	CW only	Regular signal
JA8DXB	A 29.445/29.460	SSB & CW	Regularly active
EA8NU	A 29.440	SSB	Good signal mainly A-O-8
UA9JL	A 29.435	CW only	Real T2 note (T7 given!)
RC2WBR	A 29.445	CW only	Good signal, but RX not so good

TABLE III - RS Satellite First Channel

Letter	Content	Calculation
K	Output power	0.2 x N2 = op in mW of transponder
D	Voltage of source	n x 0.2 = power source in volts
O	Charge current	20 x (100−n) = charge in mA
G	Believed to be TLM calibration constant test level	
U	Not given	
S	Temp. Regulator	T = n = Temp. of Voltage Regulator in C
W	Temp. 10m TX cooling fins	T = n = Temp. of 10-meter output stage in C

what has been done with OSCAR, and 'RS' too.

To start, presented here is such a listing, into which we would like to add your entry for comparison. Points are calculated in the same manner as the SDX award, 250 points per continent, 50 per DXCC country, 10 per different station. Later we can add 50 per state or VE or VK call area, etc. Table I may be long out of date for some. No proof needed, just your claim please.

A further point of interest may be a listing of some of the rare countries active, especially those at the extreme orbital range of the main continents, to help identification of a fleeting signal in as short a mutual access time as possible. See Table II.

Apologies for most of these being in the European theatre, but it is hoped that some input from a wider field will come along in time for the next issue of *ORBIT*.

Finally, some general news on the forthcoming 'RS' Radio Satellites that will be launched toward the end of this year. The DOSAAF (UA AMSAT) group have been busy again building new satellites to replace the highly successful but short-lived "RS-1" and "RS-2" forerunners, whose batteries are close to extinction due to the high temperatures experienced in that particular orbit. The first of these has been given a good airing by testing it as a two-to-ten repeater in Moscow. Through it your scribe worked a large number of stations in the Moscow area, by transmitting back on the downlink frequency, including UA3AR, head of the project. The beacon was on 29.450 MHz transmitting the binary derived format series similar to that of its predecessors. The translation of the channel without prefix or with 'E' prefix is shown in Table III.

There are in fact, thirty-five parameters in all, despite the seven letter prefixes, the others of which can be identified with an additional 'dit' in front of the K, D, O, etc. making them sound like different letters. 'D' would sound like 'L', 'O' like 'J' and so on. The actual format can be the same, depending on whether the service channel is on or not, thus no prefix, a straight K, D, O, G, U, S, W sequence would indicate things are quiet apart from the beacon, while 'EK', 'ED', 'EO' etc., would be sent when all is going.

Thus, with activity, prefix goes to 'E' prefix, the 'I' pre-prefix can go to 'S', e.g. 'IK' to 'SK', 'ED' to 'SD', etc., the normal non-active 'N' prefix to 'R', the normal 'A' to 'U', and the normal 'M' to 'W', all by the extra 'dit' of information. For the second channel, some of the information such as the output power of the transponder and the means of calculation are the same, but other interpretations are now employed. See Table IV.

The transponder, like the previous, being designed with the USSR two-meter five-watt power limitation in mind, shows superb sensitivity, and was producing good signals from OSCAR-7 on Mode-B downlink to its output on ten-meters, with its 145.910-950 MHz input to give 29.410-450 MHz output. A further innovation is a codestore system with a capacity of one hundred characters, which has been used to give out messages about the transponder, on 29.330 MHz e.g."CQ.... Transponder RS0 is testing Rx 145.910/950 MHz Tx 29.410/450 MHz Pse QSL via Moscow Box 88 RS3A."

The TLM can dwell on any one channel continuously, in which case, the "RS0" normally finalizing each run of telemetry is negated. The transmitters can also be placed into two different power levels, indicated by the 'MG' and 'MU' prefixes. The testing of the units will be from 1200 to 1230 each Saturday, Moscow time. Reports are appreciated, written, or on frequency 29.445 or 330 via F2 when the band is open.

Perhaps the most exciting feature of all is the autoresponder that has been successfully tested to me by demonstration. When it is called on 145.830 MHz it will respond on 29.330 MHz and actually conduct a contact with the station whose call it identifies. It will call CQ on 29.330, and the station needing a QSO should call "RS0A de (your call) AR K." The response will come back: " (Your call) de RS0 QSO Nr 001 (your call) de RS0 QSO Nr 001 OP ROBOT T U FR QSO 73 SK" and then await the next caller. It will presumeably be assigned "RS-3" or the like once in orbit, and serialize the QSO number.

RADIO magazine reports that three transponders are on the way, one transponding from 145.860-145.900 to give 29.360-29.400 MHz, with 'Robot' on 145.820

to 29.320. Another is from 145.910-950 to give 29.410-500, with its "Robot" 145.830 to 29.330 MHz (presumeably the one under test) and the other covers 145.960-146.000 MHz to give 29.460-500, with its auto-responder on 145.840 to give 29.340 MHz.

More information will be forthcoming before launch on this interesting new development by our Russian fellow-enthusiasts. It is not known yet what orbit it will take, nor exactly when. What I am trying to work out is how "ROBOT" will manage to get his QSL cards sent out, a necessary compliance for all USSR stations. If perchance you should see a small parachute coming down one morning.....?

Editor's Note: Please send all contributions to: Pat Gowen, G3IOR, 17 Heath Crescent, Hellesdon, Norwich, Norfolk, NR 66 ND England.

TABLE IV - RS Satellite Other Channels

SECOND CHANNEL: Prefix, 'I' or (active) 'S',
e.g. 'IK' or 'SK', 'ID' or 'SD' etc.

Letter	Content	Calculation
K	Output pwr transp.	As previous
D	Zero adj. of TLM	Figure given
O	Beacon output pwr	0.2 x N = Beacon output in mW
G	Sensitivity transp.	N = -dB(regulated)
U	'S' meter 1st RX	0.1 x (N-10) = 'S' units
S	'S' meter ROBOT RX	as above
W	'S' meter 2nd service RX	as above

THIRD CHANNEL: Prefix 'N' (quiet) or 'R' (active)
e.g. 'NK' or 'RK' etc.

K	As previous two 'K' channels
D-W	Regret no further information yet to hand

FOURTH CHANNEL: Prefix 'A' (inactive) or 'R' (active)
e.g. 'AK' or 'RK' etc.

K	Output power of transponder	as previous
D	9V transponder line	0.1 x N = transponder supply 'V' in volts
O	7.5V transponder line	as above
G	9V 1st stabilizer	as above
U	7.5V 1st stabilizer	as above
S	9V 2nd stabilizer	as above
W	7.5V 2nd stabilizer	as above

FIFTH CHANNEL: Prefix 'M' (inactive) or 'W' (active)
e.g. 'MK' or 'WK' etc.

K	Output power of transponder	as previous
D	On board log	N = no. of QSO's +/-1 (assumed on ROBOT)
O	Heater radiation control	N x 0.1 = watts, power of heating system
G	ROBOT input power	n x 20 = power in mW
U	Power of service channel	n x 20 = nW (assumed to be transponder Wt)
S	Sensitivity pad of ROBOT	N = -dB of ROBOT RX
W	Sensitivity of service RX	N = -dB

Mode A 10-meter converter for 432

By John Pronko, W6XN

The Lockheed Missile and Space Co's (LMSC) Amateur Radio Club decided to assemble an ultra-portable multimode OSCAR station which would be available to members for use in Amateur Satellite communication demonstrations at local schools. The ground rules were that it should be small enough to be carried in a reasonable sized brief case and that it should be caple of operating all satellite transponder modes (including Phase III A). This was indeed a welcomed package from my point of view for it meant (as a member of both the Amateur Radio Club and Project OSCAR) I would no longer have to go through the painful process of tearing down and later re-assembling my home station whenever I wanted to put on a demonstration.

At first club members felt that it was best to design and build all receive and transmit portions of the system. It soon became apparent that such an undertaking would be a monumental effort and consequently had to be abandoned in favour of a more modest approach. It was then decided to use the ICOM IC202 and IC402 as the station nucleus. These units are portable and cover the 2 meter and 70 cm bands, respectively. The club purchased a used IC202 and a new IC402 (thanks to a cash donation by the Lockheed Employees Recreational Association). A lsb modification was added to the IC202 allowing it to be used for receiving Mode-B downlink signals. The two compact ICOM units provided complete Amateur Satellite receive and transmit capabilities with the glaring exception of a 10 meter receive system.

We wanted to avoid lugging around one of the many available multiband ssb transceivers which could serve as a 10 meter receiver. It occured to me that when operating Mode-A, the IC402 would be sitting by unused. Why not turn it into a 10 meter receiver? The decision was made to build a 10 meter to 70 cm receive converter to be used with the IC402. The entire portable station and its use may be described in more detail in a subsequent article.

Up-Converter Circuitry

My experience in designing vhf/uhf circuitry is limited, however I did not let that stop me from undertaking this interesting project. Fig. 1 illustrates in block diagram form the basic circuit concept that was eventually chosen. The LO frequency was picked so as to put the entire 200-kHz satellite subband in the first crystal position of the IC402. Using a LO frequency of 402.7 MHz, 29.5 MHz transposes to 432.2 MHz and at the low end 29.3 MHz transposes to 432.0 MHz.

There are a number of published circuits available in the Amateur Radio literature which could be used for the rf amplifier and local-oscillator chain. Described below are the circuits which turned out to be the most convenient.

The 10 meter preamp circuitry, Fig. 2, was taken from a design by Jim Ouimet, K6OPO, of Project OSCAR. The circuit, one which I used earlier as a 10 meter preamp with my hf station, has a gain of 27 dB and a noise figure of 2.1 dB. The transistor (3N200) is an N-channel Si dual-gate MOSFET generally used in vhf rf circuitry. There are a number of equivalent transistors available, all of which should present approximately the same gain and noise figure as the 3N200. Some of these equivalents are 40673, SK3065 and HEP-F2007. The 3N200 transistor has diode protection incorporated into the transistor package itself. External diodes were used in the present circuit as a protection against larger signals that the internal diodes might not handle. If the diodes are not used, the value of the 5-pF capacitor may have to be changed slightly in order to bring the tuned input to the desired resonance. The transformer coils are wound on 0.48 cm diameter slug tuneable forms (0.63 cm long) mounted in shielded cans. These were purchased at a local used parts dealer.

The LO chain chosen for the converter is a circuit designed by Jim Eagleson, WB6JNN, of Project OSCAR. Jim had graciously made available a number of his circuit boards for use in various Project OSCAR

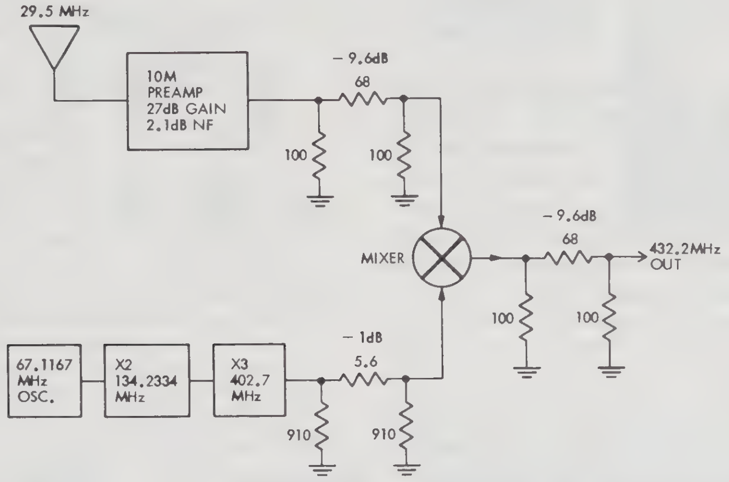


Fig. 1 - A block diagram of the basic circuit used in the ten-meter to 70-cm up-converter.

undertakings. Having had this option available made my task somewhat simpler; all I had to do was stuff them with parts and make them work. As illustrated in Fig. 1 the LO chain consists of three sections: an oscillator, a doubler and a tripler section. When tuned using a spectrum analyzer, the circuit will yield approximately 10 mW of 402.7 MHz signal with spurs down 50 dB. Tuning for maximum 402.7 MHz signal without the use of a spectrum analyzer will result in spurs that are down at least 40 dB. Fig. 3 illustrates the circuit schematically. The oscillator and doubler circuits are mounted on a single 4.3 cm by 9 cm pc board. The tripler circuit is mounted on a second similar size board along with the mixer and 10 meter preamp.

Jim originally had designed the second board with a Mode-J down converter in mind, hence the pc board traces were meant for a 435 MHz preamp, mixer and the tripler at the end of the LO chain. All but the 435-MHz preamp traces were of value for my application. Using an Exacto knife and imagination, the traces for this preamp were altered beyond recognition so as to more readily accomodate the mounting of the 10 meter preamp described earlier.

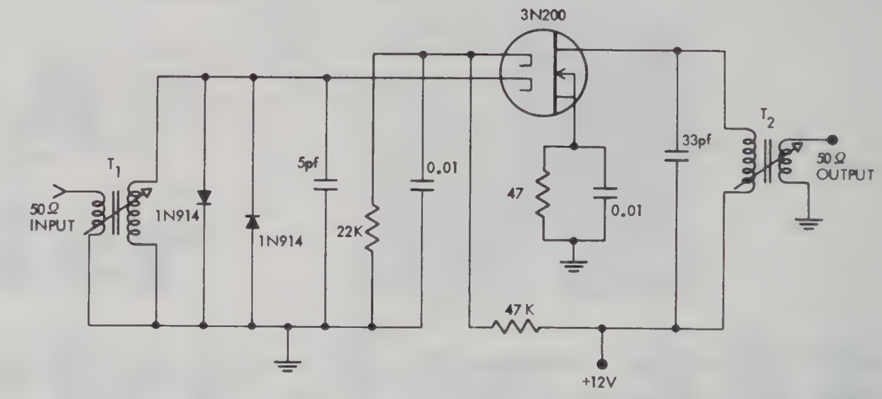
The mixer (CM-1) is a minature commercial double-balanced mixer module available from Cimmaron, a division of Vari-L. Since I did not intend to use microstrip lines for rigorous 50-ohm matching into the mixer, 50-ohm attenuator pads for masking any mismatch were placed at all ports on the mixer. It is not necessary to use any i-f tuning at the output of the mixer; the IC402 input stages serve that purpose. For more details on the use of packaged double balanced mixers see the article by Shuch .[1]

The up-converter is housed in a 5.71 cm by 10.16 cm Bud box (CU-3003-A). A 3 cm by 8 cm double-sided pc board is mounted in the base of the box on metallic standoffs. The two boards containing the circuit components stand on edge and are soldered to the above pc board such that they are parallel to each other with the components facing outward, see Fig. 4. This makes it convenient to tune the converter; however to replace any components, one of the boards must be removed to provide access to the soldered traces. In order to facilitate trouble shooting of the circuitry with one board removed from the housing, the coupling cables between the two boards initially were made longer than necessary. Input and output signals are fed through BNC connectors mounted on either end of the box. The photograph shows the up-converter and the IC402. Both units operate from a common 12-volt supply.

As indicated in Fig. 1, the 10 meter preamp has a gain of 27 dB. With only a -7 dB mixer conversion loss this large value of gain can lead to overloading the IC402 input stages. To overcome this difficulty I chose to use large values of attenuation in the pads of the rf and i-f mixer ports. The values of the attenuation pads shown in Fig. 1 were chosen to set the no-signal noise floor (with antenna connected) to ½ S-unit. There is a drawback to this approach. The total system noise figure is increased significantly because of the high values of attenuation used in the pads. An alternate approach, one which tends to preserve the advantage of the low noise figure of the 10 meter preamp, is to reduce the gain of the preamp stage so that lower attenuation values could be used in the pads at the rf and i-f mixer ports. Using the equations presented by Fisk and Krauss for determining the noise figure of cascaded stages (both passive and active) one can find optimum values of gain and attenuation which would tend to preserve the low initial noise figure.

Assuming a noise figure of less than or equal to 6 dB for the input stage of the IC402 the calculated total system noise figure for the configuration illustrated in Fig. 1 is less than or equal to 6.9 dB. According to the criteria presented by Fisk[2,3]this value is more than adequate for receivers used on the 10 meter band and any attempt at lowering the system noise figure would not necessarily lead to an improvement in reception.

Fig. 2 - Rf preamplifier circuit for the 10-meter-to-70-cm converter. T-1 primary is 3¼ turns of No. 34 enam. wire; the secondary is 23¼ turns of No. 34 enam. wire. T-2 primary is 11¼ turns of No. 30 enam. wire; the secondary is 4¼ turns of No. 30 enam. wire.



This rationale gains further credence by the fact that the system was already external noise limited when the attenuation level was set for a system noise level of ½ S-unit. The only advantage in lowering the noise figure would be if a very inefficient, miniature antenna were used with the receive system. Consequently the initial approach illustrated by the block diagram in Fig. 1 was maintained.

No measurement of the system noise figure was attempted nor was an attempt made to measure the noise figure of the IC402. However, in a test with a signal generator, I found the minimum discernable signal at the converter input to be lower than -135 dBm. Although a measurement of this kind is not considered a rigorous test of sensitivity, the results are at least consistent with the anticipated noise figure.

Summary

This 10 meter receiver has been given a thorough Mode-A tryout in the 1979 Field Day contest. It has been used in a number of receive-only OSCAR talks presented at area Amateur Radio clubs and in a school OSCAR communications demonstration. It has also been used as a satellite receiver at my home station in place of the Kenwood TS-520S. From the sensitivity point of view, it performs as well, if not better than the TS-520S. However, one is still saddled with the compressed band spread of an IC402.

If there appears to be enough interest in the circuits described, Project OSCAR will arrange to provide, at a nominal fee, the pc boards for the oscillator-doubler as well as a board with the proper layout for the 10 meter preamp-mixer-tripler circuits. Please express your interest in this matter to Project OSCAR, Inc., P.O. Box 1136, Los Altos, CA 94022, USA.

I am indebted to the following Project OSCAR colleagues for their display of patience in discussions of various aspects of this project: James Eagleson (WB6JNN), James Ouimet (K6OPO), Paul Shuch (N6TX) and Robert Stein (W6NBI).

**References*

1. H. Paul Schuch, N6TX, "Circuit packaging for UHF Double balanced Mixers," *Ham Radio*, September, 1977.

2. J. R. Fisk, W1HR, "Receiver Noise Figure, Sensitivity and Dynamic Range," *Ham Radio*, October, 1975.

3. G. H. Krauss, WA2GFP, "VHF Preamplifiers," *Ham Radio*, December, 1979.

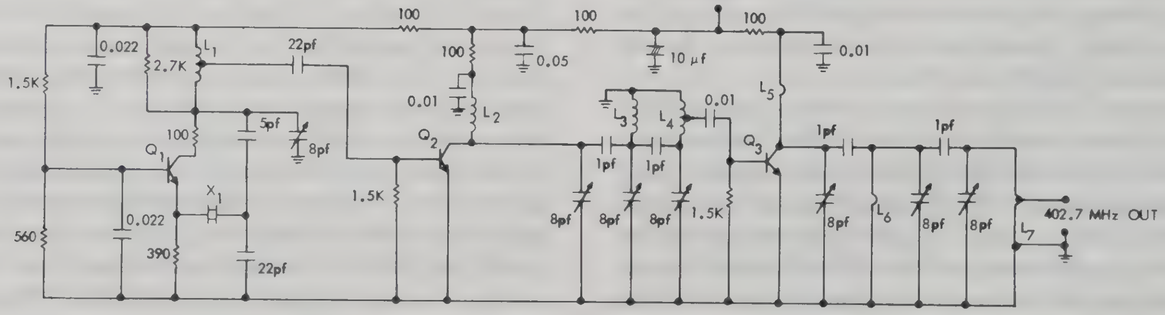


Fig. 3 - The local oscillator chain to produce 10 mW of rf at 402.7 MHz.

X-1 - 67.1167 MHz, 0.002%, series resonant, HC-18.

Q-1, Q-2, Q-3 - 2N5179.

L-1 - 15 turns No. 26 enam. wire on Amidon T-25-12 core tapped five turns from the cold end.

L-2, L-3 - Five turns No. 16 enam. wire on an Amidon T-25-12 core.

L-4 - Five turns No. 16 enam. wire on a T-25-12 core tapped two turns from the cold end.

L-5 - 1⅛-inch hairpin loop of No. 20 wire.

L-6, L-7 - 1-½ inch U-shaped loop of No. 20 wire.

LETTERS

Dear Editor:

The first issue of AMSAT's *ORBIT* magazine arrived today. Congratulations on an excellent looking publication. I hope AMSAT members can expect this type of publication every issue.

My disappointment comes from the lack of tracking information on Phase III that was missing in *ORBIT*, only to find an article on tracking Phase III using OSCARLOCATORS or SATALLABES in the May issue of *QST* (which arrived on the same day as *ORBIT*). AMSAT members should support *ORBIT* along with other publications rather than giving *ORBIT* a secondary status.—*WB6GFJ*

Editors Note: AMSAT does not restrict the dissemination of information to *ORBIT*. Anyone is free to write for any magazine using data supplied by us.

Dear Editor:

As I'm about to renew my membership in AMSAT for the fourth time I must complain (after three years of silence) over the fact that I am excluded from participation on the AMSAT nets (3850 mainly) due to the fact that it's in the Advanced portion of the band! I sit here many nights in anger that I am legally unable to join in to ask questions.

I'm sure many other Generals would also like to participate but can't do so. Whoever decided to put the net at 3850 anyway? Why not 3950? Or some other? I almost wonder if this is intentional or not?—*W4GKC*

Editors note: Technicians and apartment dwellers without antennas have similar problems. The net controls should be reading the bulletins at the start of the net.

Dear Editor:

Congratulations on the successful culmination of your dedicated efforts. The response to the first issue of *ORBIT* is extremely favorable.

With the amateur satellite program at a major transition point, the new publication can make an important contribution to our continued progress. In addition to supporting the Phase III satellite program, *ORBIT* should provide a new means of communications among the many developing international centers of amateur space technology. It should also become a focus for the growing group of nonamateur space enthusiasts. —*W6SP*

Dear Editor:

Delighted to receive the first of *ORBIT* magazine -- excellent! Format and quality of printing work is very fine.

The lead article by Joe Kasser on Phase III is a blockbuster and the articles by ZS1BI, WA2LQQ, and WD4FAB are of great interest. Overall, I am very pleased with my first issue of *ORBIT* — *W7MKW*

Dear Editor:

I am hoping that the new *ORBIT* will carry advertisements about satellite gear. This will make our shopping easier. — *W2JMR*

Dear Editor:

I hear numerous questions on the Sunday nets concerning antenna elevation control. When OSCAR-1 was placed in orbit, I was living in Illinois. I was plagued with water and icing conditions when rotors were mounted in a horizontal position, so I elected to mount the rotors in a vertical position as designed by the manufacturers.

My Mode-A system consists of two eight-element two-meter beams. I use the same two booms from these beams to support my three-element 10-meter beam. A ⅜-inch piece of Nylon rope is used to hoist the array has has not suffered any damage.

Any TV type rotor may be used in this manner. The cross-boom is made from one inch galvanized pipe or rigid conduit, which turns inside a 1-¼ inch 'T' connector with a short nipple at each end to extend the width beyond the width of the elevation rotor. On top of the 'T' I have mounted a plate with four U-bolts. The plate is drilled to accept the elevation rotor. Each end of the 'T' is notched to create a 'stop' position which limits rotation to 90 degrees. The bottom notch limits the horizontal movement.

The part that does the antenna lifting consists of two pieces of ⅜ X 12 inch rod completely threaded. A short piece of ⅜-in. Nylon rope and a piece of 1-½ X 12 inch thin wall conduit, bolted together to form an arm around the rotor.

No welding is required. A hacksaw can make the notches for the stops and the cross boom can be drilled and tapped to accept the ⅜-inch rods.

The diameter of the short piece of tubing in the elevation rotor can be selected so that one complete rotation of the rotor will cause the antenna to be raised by 90 degrees.

Weight balance is accomplished by spacing the beams equally side to side. Front-to-rear balance is done by moving the two-meter beams in one direction or another. A slight amount of off-balance is needed in the direction of the front to assure that the antenna returns to horizontal when the rope slack is left out by the rotor.

If you select one of the lower priced offset rotors such as the Alliance, CDE or Radio Shack, no plate is needed at the top of the system. Just fasten the rotor to the back part of the 'T' that connects the two rotors together. — *W4BE*

Two rotors mounted horizontally serve well as an elevation control, as noted by W4BE.

AMSAT news

- ☐ Perry Resigns
- ☐ Board Minutes
- ☐ Project OSCAR
- ☐ Board Nominations

Call for Nominations

Elections to the Board of Directors will be held at the Annual Meeting on September 13, 1980. Candidates for election may be nominated by a letter of nomination signed by at least five members. The deadline for submitting such letters of nomination is July 30, 1980. Candidates will be expected to supply background and biographical information.

Perry Klein Resigns

The AMSAT Board of Directors has been notified by AMSAT's President and General Manager, Dr. Perry Klein, W3PK, that Perry desired to begin an orderly withdrawal from his present duties as President and General Manager.

Perry has served AMSAT in a leadership capacity since its inception eleven years ago and has guided the growth of the organization from its start with a few individuals in the Washington vicinity to a world-wide organization with nearly 5,000 members. In fact, in many minds, AMSAT IS W3PK. Perry's contributions in connection with AMSAT as reflected in the professional literature as well as the Amateur Radio media have brought broad recognition and credit to this unique Amateur Radio endeavor. His many articles have marked him as an innovator and his place in the annals of Amateur Radio is assured.

Now, having shepherded the Phase III A satellite to its moment of launch, he has decided to reduce his direct, active involvement in order to pursue a new course of research, while remaining a vital consultant and President Emeritus of AMSAT.

The AMSAT Board of Directors has accepted, with deep regret, the resignation of its founder, first President and General Manager. In accord with Perry's wishes, the resignation was effective June 1, 1980.

On this date, in accord with the Bylaws, Dr. Tom Clark, W3IWI, who was AMSAT Executive Vice President assumed the office of Acting President. Vern "Rip" Riportella, WA2LQQ, was designated Acting Executive Vice President. These officers will serve until the Board of Directors convenes following the Annual Meeting to be held on September 13, 1980. At that time the Board will elect the permanent officers for the following year. The Board will also review policies concerning the position of General Manager.

To fill Perry's seat on the Board of Directors in accord with the Bylaws, the First Alternate Director, John Henry, VE2VQ, was seated.

The withdrawal of W3PK from further direct, active roles in AMSAT is a deep loss to the organization and, though the additional load borne by the officers will surely be noted, there was no delay in the planned launch of the Phase III A satellite May 23. Neither does the Board anticipate a major impact on the AMSAT-Phase IIIB as a consequence of this organizational adjustment.

Minutes of the AMSAT Board of Directors Meeting April 5-6, 1980

A meeting of the AMSAT Board of Directors was held on April 5th and 6th, 1980 at Building 22, Room 271, NASA Goddard Space Flight Center, Greenbelt, Md. The following people were in attendance (for part or all of the time) : Ron Broadbent, G3AAJ, John Browning*, W6SP, Bob Carpenter, W3OTC, Tom Clark*, W3IWI, Dick Daniels, W4PUJ, Marty Davidoff, K2UBC, Pat Gowen*, G3IOR, Peter Greed, G3MQD, Joe Kasser, G3ZCZ, Jan King*, W3GEY, Perry Klein*, W3PK, Roy Rosner, K4YV, Martha Saragovitz, Martin Sweeting, G3YJO, Bill Tynan, W3XO, Will Webster*, WB2TNC, and Rich Zwirko*, K1HTV.

Phase III Progress Report

The Phase III Progress Report was introduced by Jan King together with a slide presentation. By viewing the slides, attendees were able to see the stages of development of the AMSAT Phase III spacecraft. Problems with the IHU, relocation of the AMSAT Laboratory, qualification of the flight computer and the spin balance test were all discussed.

A discussion on the design of the Solar Cell plaque followed. Will Webster moved that AMSAT reaffirms the agreement as stated on the Solar Cell form which states "contributors of $1,000 or more will have their names placed on a plaque on the Phase III spacecraft." Details of the plaque will be left up to the technical staff. The Board voted and all were in favor.

Tom Clark reported that three stations on the East Coast are ready and have command capabilities: W1HDX, VE1SAT, W3IWI. He then acknowledged the contributions of John DuBois, W1HDX, Ron Dunbar, W0PN, John Fox, W0LER, and George Johnson, W0MD. Rich Zwirko, K1HTV, announced that the operations group does not want to encourage DXCC and added that ARRL will not give an award for DXCC on the Phase III satellite.

AMSAT Administrative Policies

After a brief discussion on the dues increase, Pat Gowen moved that an amendment to the AMSAT Bylaws be made stating that dues should be set at the amount decided at the 1979 Annual Meeting or at a pro rata decided upon by the Board. The vote on this motion was unanimous.

AMSAT External Relations with Affiliate Organizations

Pat Gowen gave a quick review of his relationship with AMSAT-UK. Ron Broadbent, Peter Greed and Martin Sweeting then discussed the composition of AMSAT-UK which is comprised of a separate technical and administrative component. It was agreed by those AMSAT-UK members present to provide articles for *ORBIT*. In addition, they will offer *ORBIT* for sale in the U.K.

A discussion concerning the establishment of a new international AMSAT organization was introduced by AMSAT-UK. Jan King moved that the Board accept AMSAT—UK's suggestion to form a new international AMSAT organization. It was also recommended that an international meeting involving AMSAT affiliate organizations be held at the University of Surrey within the next six months to define the new structure. All Board Members were in favor.

Tom Clark suggested that the AMSAT policy of Board Members and Senior Officers of the organization attending at least one major convention of a national or regional organization be reaffirmed. The vote was six in favor and one opposed.

John Browning agreed to write a letter of apology for the late cancellation of an AMSAT representative at the ARRL SE Division Convention/Tropical Hamfest.

IARU and Societies: Tom Clark presented a proposal to distribute an issue of *ORBIT* carrying Phase III wrap up material to all IARU societies shortly after launch. This would be accompanied by permission to reprint all Phase III related material and to offer to supply reproducible quality photos. This action was assigned to the *ORBIT* staff. The Board unanimously approved.

Tom also agreed to pursue with the IARU some mechanism for the inclusion of the Amateur Satellite Service in the IARU organization.

Ad Hoc WR3ABU Advisory Committee Report

Bill Tynan, W3XO, Bob Carpenter, W3OTC, Tom Clark, W3IWI, Joe Kasser, G3ZCZ, and Perry Klein, W3PK met to discuss the future of the two-meter fm repeater. It was moved by Rich Zwirko that AMSAT continue the use of the Washington area two-meter fm repeater which is used as a local intercom and that the use of the system should be encouraged. The Board agreed and allocated the sum of not more than $100 for expenses. Thanks were given to those involved in helping maintain the AMSAT repeater on the air over the last few years.

*Board Member

The Board voted unanimous approval to Tom Clark's motion that the Officers of the Board provide local Washington area public relations, in particular with respect to Autocall magazine and the Foundation for Amateur Radio. In addition, the Board voted to concur in the recommendation published by Bill Tynan in *QST* regarding the use of a VHF/UHF liaison frequency in the Phase III passband.

ORBIT Magazine and OSCAR Handbook

After Marty Davidoff reported on his progress with his satellite handbook, to be published by the ARRL, Tom Clark moved that the handbook be reviewed and then sanctioned as an official AMSAT publication and thanked Marty for his activities in support of AMSAT.

In order to encourage the overseas distribution of *ORBIT*, it was decided by the Board that *ORBIT* be supplied to overseas affiliates/societies at cost. Such affiliates/societies would set their own retail prices in local currency. This policy would be reviewed again after a trial period of one year.

AMSAT Finances

Tom Clark proposed that Executive Officers be directed to have the Financial Advisory Committee review the portfolio and submit a report to the Board of Directors no later than July 1, 1980. The Board then voted to accept with thanks the audit of management and accounting procedures of the organization by Taylor Klett, KA5EIM. It directed the Financial Committee to examine the report and prepare recommendations for implementing those portions which are appropriate and to provide reasons for not implementing any remaining portions.

Setting of Life Member reserves rate: The Board of Directors reaffirmed that 50% of the Life Member contributions be allocated for the Life Member reserves.

The Board then noted with thanks the long and diligent service of Bill Hook, W3QBC, who has announced that he was stepping down as Assistant Treasurer after serving for many years as Treasurer and later as Assistant Treasurer.

UOSAT Progress Report

Martin Sweeting of the University of Surrey reported on the development of the UOSAT project. The Board decided to place a separate accounting category in the expense book for this project.

Other Business

After discussing conflict of interests, the Board approved a motion stating no member of the Board of Directors may be simultaneously paid as an employee of the organization. Also mentioned was AMSAT's commitment to try to maintain the 20-meter net.

Education: Peter Greed stated that the full impact of the educational use of the AMSAT OSCAR satellites has not yet been realized. He requested permission of the Board to approach the AMSAT affiliate organizations to inquire as to the state of the educational programs and to identify the person involved in promoting such work.

The date of the Annual Meeting will be Sept. 13 at the NASA Goddard Employees Recreation Center, Greenbelt, Maryland, followed by Board of Directors meetings on Sept. 14 and 15.

Addendum to Minutes

A) Board of Directors appointed a subcommittee to investigate alternative premises for the administrative branch of the organization. This subcommittee is comprised of Perry Klein, Will Webster, Roy Rosner and Martha Saragovitz.

B) Ron Broadbent thanked the Board of Directors for the opportunity to attend the meeting. John Browing thanked Perry Klein for his efforts on Phase III.

C) The Board of Directors approved Jan King as the liaison with Delta and UOSAT.

D) Tom Clark reviewed the action items from the last Board of Directors Meeting.

Project OSCAR Minutes

Project OSCAR, Inc. held its annual general meeting on February 13, 1980 at the Electronic Museum, Foothill College, Los Altos, Ca. This annual event attracted 41 attendees. The meeting was officiated by president John Pronko, W6XN, whose introductory remarks contained a summary of the years major activities.

James Eagleson, WB6JNN, spoke about the technical progress and experiences garnered from the organizations's experimental 23 cm linear translator. This system, located on Mt. Umunhum near San Jose, Ca., is similar in concept to translators presently used aboard amateur satellites with the exception that the input and output frequencies are centered on 1296.3 and 1239.5 MHz, respectively. Much valuable data is being provided toward the concept of using microwave transponders in the amateur satellite service. A two-meter input has recently been installed to facilitate the use of the translator by individuals not yet geared up for full duplex on the 23 cm band.

John Browning, W6SP, chairman of the AMSAT Board of Directors spoke concerning recent developments within AMSAT as well as Project OSCAR's relationship to the AMSAT organization. Discussions were held regarding an increased role by Project OSCAR members in activities supportive of the amateur satellite service.

John Pronko, W6XN, spoke about the details of generating the Project OSCAR orbital calendar and the problems involved in predicting accurate long term data during this period of high solar activity. It was decided to continue the production and distribution of a three month orbital calendar for AO7 and AO8. The calendar is available free of charge by sending a s.a.s.e with enough postage for one oz. of material, to Project OSCAR,Inc., Post Office Box 1136, Los Altos, CA 94022, USA.

Raymond Vincent, W6PUX, presented the latest results of the WARC conference, in particular, how it effected the amateur satellite service. Since much of experimentation by Project OSCAR members lie at uhf and microwave frequencies it was gratifying to see an increase in the microwave frequencies alloted to the amateur satellite service.

Election of eight of the fifteen members of the Board of Directors was held and the following were instated as board members for a two year term: John Browning, W6SP, William Eitel, W6UF, Lance Ginner, K6GSJ, Eugene Root, WB6OOO, Paul Shuch, N6TX, Robert Stein, W6NBI, Chuck Townes, K6LFH, and Raymond Vincent, W6PUX. The alternate seven members were elected the previous year and are: James Eagleson, WB6JNN, Claude Lievsay, N6OO, Nick Marshall, W6OLO, James Ouimet, K6OPO, Cameron Pierce, K6RU, John Pronko, W6XN and Walter Read, W6ASH.

Historically, Project OSCAR had its roots in the San Francisco Bay area where most of the active members were located at the time of the development and launch of OSCAR-1. However, in an attempt to tap more of the technical talent and resources that exist on the west coast of the United States a second meeting was arranged and held on March 9, 1980 in El Segundo, Ca. The intent of that meeting was to break tradition and extend the reach of the Project OSCAR organization into the southern California area where there was strong potential support for participation in the amateur satellite service.

The meeting was organized by John Browning, W6SP, and John Pronko, W6XN, and was attended by 52 people from the Los Angeles and San Diego areas. This meeting, the first of its kind in that area, was a huge success; enthusiasm by attendees for participation in the activities of the amateur satellie community was evident.

The formal aspects of the meeting consisted of a presentation by John Browning, W6SP, on the history of the amateur satellite service from OSCAR-1 through OSCAR-8. This included the early role of Project OSCAR and the later role of the Washington, D.C. based AMSAT organization. John Pronko, W6XN, discussed the technical aspects and experiences gained from using Project OSCAR's 23 cm linear translator as well as the potential use of such a translator on a geostationary satellite. This portion of the program was followed by a discussion of AMSAT's Phase III satellite as well as a presentation of circularly polarized antennas for 435 MHz built by members John Fail, KL7GRF, Victor Ruebhausen, W6WNK, and Dennis Dinga, N6DD. John Pronko, W6XN, displayed and discussed a KLM prototype circularly polarized antenna for use in Phase III and mode B operations. The antenna consists of two ten-element cross-polarized, phased beams using folded-dipole driven elements and a relay system for changing the sense of polarization. This antenna is now available from KLM Electronics.

The meeting was then opened to general discussions of the satellite program and how attendees could become more deeply involved in Project OSCAR's activities supportive of AMSAT's major goals.

Three individuals were nominated for leadership roles in the future activities of the Southern California arm of Project OSCAR: Cleon Yowell, AD6P, Victor Ruebhausen, W6WNK, and Douglas Millar, K6JEY.

In the opinion of the organizers this meeting was a resounding success and will no doubt be held as freqently just as the meetings in the San Francisco Bay area.

Annual Meeting Announcement

The Annual Meeting will be held at 8:00 P.M. on Saturday, September 13, 1980 at the NASA Goddard Space Flight Center Employee Recreation Center in Greenbelt, Maryland. The largest Chesapeake area hamfest, the Gaithersburg Hamfest will be held the next day. Why not combine the Annual Meeting with a visit to the hamfest.

Directions to the NASA Goddard Employee Recreation Center: Take the Baltimore-Washington Parkway to the Greenbelt Road exit (Rt. 193), and take Greenbelt Road east 1.5 miles to Soil Conservation Road (on the left). Turn left onto Soil Conservation Road and go 0.1 mile to the first gate you come to on the right. Go through this gate, continue straight following the signs to the Goddard Recreation Center Building.

There will be a forum in the afternoon to discuss future AMSAT plans followed by an AMSAT dinner at 6:00 P.M. at the Goddard Employee Recreation Center. Please let us know if you can join us so that we can firm up reservations.

The 146.235/835 AMSAT repeater will be available for talk-in before the dinner and the meeting. (Please note the new frequency.)

K6PGX **W6ZN** **W6SP**

Phase III Program Update: Just two days after we go to press with this issue of *ORBIT*, The European Space Agency council meets (June 27) and may consider a proposal from AMSAT for another 'ride' on the next Ariane launch. More details in the next issue of *ORBIT*.

On a related matter, *Popular Science* for July and *Aviation Week* for June 9 both contain information on the Ariane launch failure last month. Much of the information was supplied by DJ4ZC and a photo by W4PUJ was published. Both of these subjects were covered in the June 20 issue of *HR Report*.

LIFE MEMBERS

AMSAT greatfully acknowledges donations of $100 or more from the following new Life Members.

Carlos Yerian, W2AAV
Richard Jansson, WD4FAB
Kent D. Taylor, K4AHU
Luciano Bertucci, TR8BL
Robert Warner, WA0KVW
Olivier Noverraz, HB9BBN
Thomas Wulling, WB0JZX
C. W. McElwee, K3QMK
John E. Fail, KL7GRF
Ronald Vanke, K8YAH
Michael B. Wolffe, ZS1CO
Jim Jones, VK8ZJJ
Bernard Joseph, K8LIX
Fried Heyn, WA6WZO
Thomas Wheeler, Jr., WA5UIL
Gordon Jensen, W7UFE
Hale Faris, K6DFY
Gerard King, WB4UUE
John M. Barnes, WD6EAK
J. Craig Caston, AA6PY
Richard Ladisky, WA1NSJ
Ivan Makovec, W9AFW
Thomas Jelks, Jr.
T. Graf Buckenmaier, Jr., KG4U
Masao Tanikawa, JR1HAL
Knud Lauritsen, OZ1WN
J.R. Buckler, N4NE
Louie Stober, WA7GCS
Wayne Overbeck, N6NB
James Wilmerding, WB2SKA
Fernando Munoz, XE1AAK
Juanita Munoz, XE1HT
Mikiyasu Nakayama, JR1SWB
Lawrence Stoskopf, N0UU

Joseph Borsch, W7PNS
Jose A. Amador, CO2JA
Harry Bluestein, N6TE
Wilhelm Weiskirchen, DC9DU
Wally Bernath, K4UAS
George T. Tew, N5AME
David Man Ho Luk
R.W.L. Limebear, G3RWL
Wayne Knabb, WB5MUM
Etienne Gijkiere, ON7AZ
William Gilmore, Jr., WB8FPQ
David Fine, W0DF
Ronald Clement, W7QU
Ross Biggar, ZL1WN
Dr. Hans Rath, DL6KG
Wilse Morgan, KL7CQ
Ken Yeatheard, VE6KY
Dave Ralph, VK4ASB
Junior L. Tuttle, KA9DCJ
Dexter Berwald, K2SBQ
Jan Hattingh, ZS6BMN
Robert C. Smith, K5VRF
Rolf Evensen, LA7AE
R.D. Kalischer, K8EM
Kenneth Kucera, KA0Y
Bruce Darvas, WB2HZE
Lee Wong, WB6GVB
John B. Wilson
Fred C. Lamb, WD8KVW
Joe Flaska, WB0RLY
Harold Mundy, KB2ER
Frank G. Waring, AF4D
Mercer Richardson, K0VIF
Woodrow Huddleston, K4SCL

W. Vern Hajek, K6UGS
James Wiman, WD9ICG
Jules Beaudoin, W1GPY
Robert Sondack, VE2ASL
Raymond Holcomb, WB5ZGW
Robert Nickels, WA0OHO
Bjorn Garpman, SM6EBM
J. Raymond McGrath, K7CUY
Charles Voelke, KB6BE
Ronald Viets, WA4SNL
Jose Vicente, PY2AUC
Curt Huff, N2CH
Helios Chasko, PY5BK
Willy Mets, ON1MT
Fabio Rossi, HB9MAD
Richard C. Beerman, N4EL
Al Welch, KB8NV
Gary Jacobs, WA4PDM
Bob Christiansen, KB2EF
Nubuo Aida, KA1KXT
Edward C. Smith, KA0BTH
J. Shillito
Robert Dilworth III, W4LQE
Dieter Schliemann, KC4AA
John McDonald, WB4ZXS
Gordon Fuller, WB6OVH
Kiyokazu Ohtsuka, JJ1JTH
Nellie Saltiel de Lazaro, XE1CI
Max Bachi, XE1XA
Richard Heindel, WB8KRN
James Opdyke, WA9JTX
Jerre F. Hersh, Jr.
David Bland, KB0GR
Charles Wilson, Jr., K4CAV
R.G. Burggraf, W8PGP
Alexander Hansken, KB3GI
Fabio Lava, HB9AUS
D.G. Steward, W4AFI
John L. Rehak, N6HI
Akio Shimizu, AA5K/JA3JM
Yutaka Nishimura, JA1TAZ

Area Coordinator Update

Please make the following additions or changes to the list published in the first issue of *ORBIT*.

Hungary - addition
Andras Gschwindt, HA5WH, Budapest Technical University, Egri, J16, H-1111, Budapest.

Italy - substitution
Domenico Marini, I8CVS, Via A. de Gasperi 97, 80059 Torre del Greco (Napoli), tel. (801) 8818144.

Switzerland - change of address
Ted Vogel, HB9OP, Pervallon, CH du Leman CH1297 Founex/Vd. Tel (022) 764242.

International AMSAT Meeting to be Held in September

AMSAT—UK will host an International AMSAT Meeting to be held at the University of Surrey, England on 19-22 September 1980. For further details contact Ron Broadbent, G3AAJ, 94 Herongate Road, Wanstead Pk., London E1 25 EQ England.

AMSAT Design Team to Stay Intact

The 'hard-core' design team for both spacecraft and ground station hardware and software is to stay intact in order to construct the Phase IIIB Spacecraft.

Both Jan King, W3GEY and Karl Meinzer, DJ4ZC had previously indicated that they would reduce the scope of their participation in the construction of flight hardware for the OSCAR Satellite series following the successful launch of the Phase III Satellite. They both felt that ten years of their lives spent in this phase was enough and it was now time to spend some time with their families and live a normal life.

The launch malfunction resulted in a change of heart for both of them. Jan is to stay in Washington and has agreed to spend at least two years working for AMSAT so as to complete the Phase IIIB Spacecraft.

The other members of the hard-core team are also of a mind that it can be done again. The prospects for Phase IIIB are thus looking better and better!

John M. Adams, W6UBJ
C.W. Pantel, K0IIR
Kerry LaDuke, KA7DLC
Willis (Bill) Freested, WB6WLL
James Ford, N6JF
G.J. Whiteside, VK5GW
David Knaus, WA9POV
Willard H. Patton, K6OQO
Harry Loretz, W6GWW
John G.P. Van Iersel, PA3APR
N.T.M. Janssen, PA0DLO
George G. Chandler, Jr., W2HRB
Pascal Perdriau
Jean-Pierre Haricot, F1BDT
Kenneth Hensey, WA9ARE
Charles Craven, WB9PUB
Anderson Rickey Tillman, WA4NVM
Don Fletcher, AC7P
Al Lee, W6KQI
Donald Drennan, W2EBF
Glen Reid, K5HGB
G.V. Sulu, VU2GV
William Fageol, WD9DSU
C.R. Wilson, K1GVA
Bob Collins, W6WBY
Morton Miller, W6HEW
W.O. Porter, W5FAH
Andre Montald
Ronny Gandy, KB5GU
Arthur E. Roberts, W1GOM
Noel Hunkeler, HB9PJD
Julian Macassey, N6ARE
David Oman, VE3SAT
Lyle Pattison, VK2ALU
Thomas J. Boyd, Jr., W5QVZ
Alan D. Scher, WD8PKF
Quintus C. Wilson, WA1LTH
Stanley Pryga, W6WJ
Harry Hood, W3DXK
A.N. Williams, Jr., WB3GPM
Gerry Gervais, N2GG
Thomas M. Webb, WA9AFM
Bob Eldridge, VE7BS
Donald Dawson, WB9LKY
Bill Nash, W6ATU
Neal Blochinger, W4LKL
Walt Amos, K8CV
Samuel B. Davis, N8BLJ
Jeffrey Bishop, W7ID
Rudi Schoeneberger, DL8DF
Richard Hagerman, N4BUB
Jean-Louise Maridet, F1DYD
Jeff Garrett, ZL1BIV
Victor Sung, VS6HS
Michael Durket, KB6VN
Hilary Osborn, Jr., K4DYB
Carolyn Osborn, N4BKD
George Perrine, K1GP
Alberto Sannazzaro
Charles Andre Lamontagne, VE2IB
C. Proctor, VK2BOZ
Craig Scherer, WA0WTG
Thomast Earnest, W5UFO
Richard Peacock, W2GFF
Rev. Marshall Moran, 9N1MM
W.B. Graham, K6QB
Daniel Davitt, N6CGB
George Henderson, AK5R
George Richardson, WB6HOZ
K.H. Bailey, Jr., W4FMN
Lionel Oubre, K5DPG
Graham Fenner, ZS6BMO
Paul Friebertshauser, W6YMV
Paolo Uccelli, IW5AEL
Claude Lievsay, N6OO
Walter Guse, W9TGB
Pierre Bachelin, F6COB
Antennes Tonna, F9FT
Robert Culbertson, WA3YGO
Etley Jenkins, WA8QMK
Stan Wood, WA4NFY
Courtney Duncan, N5BF
David Boyd, W3IFY
Clay Fisher, W6AFQ
A.T. Ross, K4CAW
Bertha Roylance, K7CHA
Edwin Ebert, HB9BQJ
Dr. Fred T. Perry, W1WFZ
Derk Van Der Bent, PE1ANE
Willem Lemmens, ON6LW
Paul A. Wussow, WA9GMW
Claude Gull, F6DGY
Marcel Bonnafe, F6EAK
Thomas L. Bishop, K0TLM
Rainey Milligan, WB5TRB
Hiromitsu Tahara, JA4FVV
C.G. Gray, W7HZJ
Earl Colwell, W9HAD
G. Ed King, K8OT
William Gardner, W8WG
Ralph Anderson, K0NL
R.W. Ruedisueli, W4OWA
James Skoog, WD0EEL
Dan Babin, K5KQG
L.R. Luchi, W7KZE
John Noel, VE6AMW
Christopher Wachs, WA2KDL
John McAulay, WA6QPL
Norman Guilford, G8SMQ
Ben W. Michel, WB7RMB
Herbert Lion, W6OWL
Rene Ponce, F6AHH
Mr. Mateu F6KJM
R.D. Boudinot, K5ZUV
Nikki Boyd, K5ADQ
Michael Cauley, AK8Y
Ray Wentz, W6LPW
Dan Howard, VE3BIR
Claude Pressler, W5VVR
J. Otto Lotz, W5HCO
Lyle V. Johnson, WA7GXD
George Francisco, DU1GF
John Dilks, K2TQN

Orbital Predictions

A07 PERIOD (min/orbit) = 114.9521618 - (3.811×10^{-7}) x (orbit number)
ANG. INC. (deg/orbit) = 28.7374

A08 PERIOD (min/orbit) = 103.2407098 - (3.1017×10^{-6}) x (orbit number)
ANG. INC. (deg/orbit) = 25.810364 - (6.502×10^{-7}) x (orbit number)

The following summary is a supplement to the quarterly calendar published by Project Oscar, Inc. It includes the above equations which represent a projected correction for atmospheric drag.

U.T.C. DATE	-- AMSAT-OSCAR 7 -- TIME (HMM:SS)	DEG.	ORBIT NUMBER	-- AMSAT-OSCAR 8 -- TIME (HMM:SS)	DEG.	ORBIT NUMBER	SCHED. MODE
SUN. 1 JUNE (153)	131:38	93.7	25361	100:33	66.9	11416	J
MON. 2 JUNE (154)	30:57	78.5	25373	105:25	68.2	11430	A
TUE. 3 JUNE (155)	125:12	92.1	25386	110:18	69.4	11444	A+J
WED. 4 JUNE (156)	24:30	76.9	25398	115:10	70.6	11458	X
THU. 5 JUNE (157)	118:46	90.5	25411	120:03	71.9	11472	A
FRI. 6 JUNE (158)	18:04	75.4	25423	124:55	73.1	11486	A+J
SAT. 7 JUNE (159)	112:19	89.0	25436	129:47	74.4	11500	J
SUN. 8 JUNE (160)	11:38	73.8	25448	134:39	75.6	11514	J
MON. 9 JUNE (161)	105:53	87.4	25461	139:31	76.8	11528	A
TUE. 10 JUNE (162)	5:12	72.3	25473	1:11	52.3	11541	A+J
WED. 11 JUNE (163)	59:27	85.8	25486	6:03	53.5	11555	X
THU. 12 JUNE (164)	153:42	99.4	25499	10:55	54.8	11569	A
FRI. 13 JUNE (165)	53:00	84.3	25511	15:48	56.0	11583	A+J
SAT. 14 JUNE (166)	147:15	97.9	25524	20:40	57.2	11597	J
SUN. 15 JUNE (167)	46:34	82.7	25536	25:31	58.5	11611	J
MON. 16 JUNE (168)	140:49	96.3	25549	30:23	59.7	11625	A
TUE. 17 JUNE (169)	40:08	81.1	25561	35:15	61.0	11639	A+J
WED. 18 JUNE (170)	134:23	94.7	25574	40:07	62.2	11653	X
THU. 19 JUNE (171)	33:41	79.6	25586	44:59	63.4	11667	A
FRI. 20 JUNE (172)	127:56	93.2	25599	49:51	64.7	11681	A+J
SAT. 21 JUNE (173)	27:15	78.0	25611	54:42	65.9	11695	J
SUN. 22 JUNE (174)	121:30	91.6	25624	59:34	67.2	11709	J
MON. 23 JUNE (175)	20:48	76.4	25636	104:26	68.4	11723	A
TUE. 24 JUNE (176)	115:03	90.0	25649	109:17	69.6	11737	A+J
WED. 25 JUNE (177)	14:22	74.9	25661	114:09	70.9	11751	X
THU. 26 JUNE (178)	108:37	88.5	25674	119:01	72.1	11765	A
FRI. 27 JUNE (179)	7:56	73.3	25686	123:52	73.3	11779	A+J
SAT. 28 JUNE (180)	102:11	86.9	25699	128:44	74.6	11793	J
SUN. 29 JUNE (181)	1:29	71.8	25711	133:35	75.8	11807	J
MON. 30 JUNE (182)	55:44	85.3	25724	138:26	77.1	11821	A
TUE. 1 JULY (183)	149:59	98.9	25737	0:06	52.5	11834	A+J
WED. 2 JULY (184)	49:18	83.8	25749	4:57	53.7	11848	X
THU. 3 JULY (185)	143:33	97.4	25762	9:48	55.0	11862	A
FRI. 4 JULY (186)	42:51	82.2	25774	14:40	56.2	11876	A+J
SAT. 5 JULY (187)	137:06	95.8	25787	19:31	57.4	11890	J
SUN. 6 JULY (188)	36:25	80.6	25799	24:22	58.7	11904	J
MON. 7 JULY (189)	130:40	94.2	25812	29:13	59.9	11918	A

U.T.C. DATE	-- AMSAT-OSCAR 7 -- TIME (HMM:SS)	DEG.	ORBIT NUMBER	-- AMSAT-OSCAR 8 -- TIME (HMM:SS)	DEG.	ORBIT NUMBER	SCHED. MODE
TUE. 8 JULY (190)	29:58	79.1	25824	34:04	61.2	11932	A+J
WED. 9 JULY (191)	124:13	92.7	25837	38:55	62.4	11946	X
THU. 10 JULY (192)	23:32	77.5	25849	43:46	63.6	11960	A
FRI. 11 JULY (193)	117:47	91.1	25862	48:37	64.9	11974	A+J
SAT. 12 JULY (194)	17:05	75.9	25874	53:28	66.1	11988	J
SUN. 13 JULY (195)	111:20	89.5	25887	58:19	67.3	12002	J
MON. 14 JULY (196)	10:39	74.4	25899	103:10	68.6	12016	A
TUE. 15 JULY (197)	104:54	88.0	25912	108:01	69.8	12030	A+J
WED. 16 JULY (198)	4:12	72.8	25924	112:52	71.0	12044	X
THU. 17 JULY (199)	58:27	86.4	25937	117:43	72.3	12058	A
FRI. 18 JULY (200)	152:42	100.0	25950	122:33	73.5	12072	A+J
SAT. 19 JULY (201)	52:00	84.8	25962	127:24	74.7	12086	J
SUN. 20 JULY (202)	146:15	98.4	25975	132:15	76.0	12100	J
MON. 21 JULY (203)	45:34	83.3	25987	137:05	77.2	12114	A
TUE. 22 JULY (204)	139:49	96.9	26000	141:56	78.4	12128	A+J
WED. 23 JULY (205)	39:07	81.7	26012	3:34	53.9	12141	X
THU. 24 JULY (206)	133:22	95.3	26025	8:25	55.1	12155	A
FRI. 25 JULY (207)	32:40	80.1	26037	13:16	56.4	12169	A+J
SAT. 26 JULY (208)	126:55	93.7	26050	18:06	57.6	12183	J
SUN. 27 JULY (209)	26:14	78.6	26062	22:56	58.8	12197	J
MON. 28 JULY (210)	120:29	92.2	26075	27:47	60.1	12211	A
TUE. 29 JULY (211)	19:47	77.0	26087	32:37	61.3	12225	A+J
WED. 30 JULY (212)	114:02	90.6	26100	37:27	62.5	12239	X
THU. 31 JULY (213)	13:20	75.4	26112	42:18	63.8	12253	A
FRI. 1 AUG. (214)	107:35	89.0	26125	47:08	65.0	12267	A+J
SAT. 2 AUG. (215)	6:54	73.9	26137	51:58	66.2	12281	J
SUN. 3 AUG. (216)	101:09	87.5	26150	56:49	67.5	12295	J
MON. 4 AUG. (217)	0:27	72.3	26162	101:39	68.7	12309	A
TUE. 5 AUG. (218)	54:42	85.9	26175	106:29	69.9	12323	A+J
WED. 6 AUG. (219)	148:57	99.5	26188	111:19	71.2	12337	X
THU. 7 AUG. (220)	48:15	84.3	26200	116:09	72.4	12351	A
FRI. 8 AUG. (221)	142:30	97.9	26213	120:59	73.6	12365	A+J
SAT. 9 AUG. (222)	41:48	82.8	26225	125:49	74.9	12379	J
SUN. 10 AUG. (223)	136:03	96.4	26238	130:39	76.1	12393	J
MON. 11 AUG. (224)	35:22	81.2	26250	135:28	77.3	12407	A
TUE. 12 AUG. (225)	129:37	94.8	26263	140:18	78.5	12421	A+J
WED. 13 AUG. (226)	28:55	79.6	26275	1:56	54.0	12434	X
THU. 14 AUG. (227)	123:10	93.2	26288	6:46	55.2	12448	A
FRI. 15 AUG. (228)	22:28	78.1	26300	11:36	56.4	12462	A+J
SAT. 16 AUG. (229)	116:43	91.7	26313	16:25	57.7	12476	J
SUN. 17 AUG. (230)	16:01	76.5	26325	21:15	58.9	12490	J
MON. 18 AUG. (231)	110:16	90.1	26338	26:05	60.1	12504	A
TUE. 19 AUG. (232)	9:35	75.0	26350	30:54	61.4	12518	A+J
WED. 20 AUG. (233)	103:49	88.5	26363	35:44	62.6	12532	X
THU. 21 AUG. (234)	3:08	73.4	26375	40:33	63.8	12546	A
FRI. 22 AUG. (235)	57:23	87.0	26388	45:23	65.1	12560	A+J
SAT. 23 AUG. (236)	151:37	100.6	26401	50:12	66.3	12574	J
SUN. 24 AUG. (237)	50:56	85.4	26413	55:02	67.5	12588	J
MON. 25 AUG. (238)	145:11	99.0	26426	59:51	68.8	12602	A
TUE. 26 AUG. (239)	44:29	83.8	26438	104:40	70.0	12616	A+J
WED. 27 AUG. (240)	133:44	97.4	26451	109:30	71.2	12630	X
THU. 28 AUG. (241)	38:02	82.3	26463	114:19	72.4	12644	A
FRI. 29 AUG. (242)	132:17	95.9	26476	119:08	73.7	12658	A+J
SAT. 30 AUG. (243)	31:35	80.7	26488	123:57	74.9	12672	J
SUN. 31 AUG. (244)	125:50	94.3	26501	128:47	76.1	12686	J

Comets

☐ Attention all computer and calculator users including both members and non-members of AMSAT. A software exchange of programs dealing with satellites, Amateur Radio and related subjects is being formed. We need your input. We are developing a detailed questionaire to organize and speed distribution of the programs. Please send s.a.s.e. to AMSAT Software Exchange, P.O. Box 338, Ashmore, IL 61912.

☐ DXPO 80 is coming September 27 and 28, 1980 at the Ramada Inn Tysons Corner, Virginia at the junction of Route 7 and I-495.

For more details on the program, which includes satellite matters, contact Dick Vincent, K3AO, Route 1, Box 230, Bryantown, MD 20617.

☐ Sign up now! Join the "Every Member Gets a Member" program now under way. Success of future satellite programs comes through support of AMSAT. If you're not a member now, please join. See page 32 for more details.

☐ *Payload Retrieval* is new. It's your chance to offer your opinion on the contents of *ORBIT*. Voting form appears on page 32.

Radio World

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Joe Kasser, shown here as G3ZCZ/JA4 outside the Intelsat Satellite Earth Station at Yamaguchi, Japan.

Comets

A New Book By K4TWJ

OSCAR: The Ham Radio Satellites

Old timers who feel that the good old days of amateur radio are gone forever, newcomers disenchanted with over crowded HF bands and just about anybody looking for new challenges will find Dave Ingram's latest publication very reassuring. *OSCAR: The Ham Radio Satellites* is packed full of information and inspiration for all. Dave, K4TWJ, starts off with some exciting history giving us an insight into the revolutionary changes that have been taking place in amateur radio since the dawn of the space age. For instance, one hears a lot of talk these days about Phase III, but do you recall or are you even aware of all the exciting events that have let us to Phase III? Who are some of the prominent players? How are amateur satellites designed, built, tested and finally launched? What is AMSAT and who pays for the Amateur Satellite Communication program? K4TWJ gives us some of the answers to these and many other questions.

Satellite operating brings a whole new dimension to amateur radio. Dave discusses this dimension and the fun of achieving real DX on the vhf and uhf bands. In fact, as Dave points out, Phase III will give us "the equivalent of a new amateur band with the range capability of 20 meters, the reliability of 2 meters, and the traffic handling ability of 80 meters."

In Dave's book, you will find chapters telling you how to set up your OSCAR earth station, including descriptions of some equipment and antennas available off the shelf from an equipment dealer. Once on the air operating through OSCAR requires some very special techniques, especially when you're after some real DX. Dave tells you how and speaks from his own experience as K4TWJ.

The book also contains a very interesting chapter that deals with the specifics of satellite tracking and includes several programs for those hand-held programmable calculators. He even includes one for the elliptical orbits of Phase III. But be careful, as Dave cautions, don't get so interested in satellite tracking that you miss all the other fun.

OSCAR: The Ham Radio Satellites is not a highly technical book. It is enjoyment oriented and contains lots of photos. The approximately 100 pages of text includes appendices containing a glossary of OSCAR terms, sample log sheets, international prefixes and much more. The book is available in paperback form and is TAB Books publication number 1120. It is available by mail order from AMSAT, P.O. Box 27, Washington, DC 20044. Include $4.95 plus $1 for first class postage ($2 overseas airmail). —*W4OWA*

Henry Radio

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There'll be a new AMSAT/OSCAR Phase III satellite — and when it comes, it will open the door to a whole new world of Amateur Satellite Communications for all hams. It's like an exciting new band.

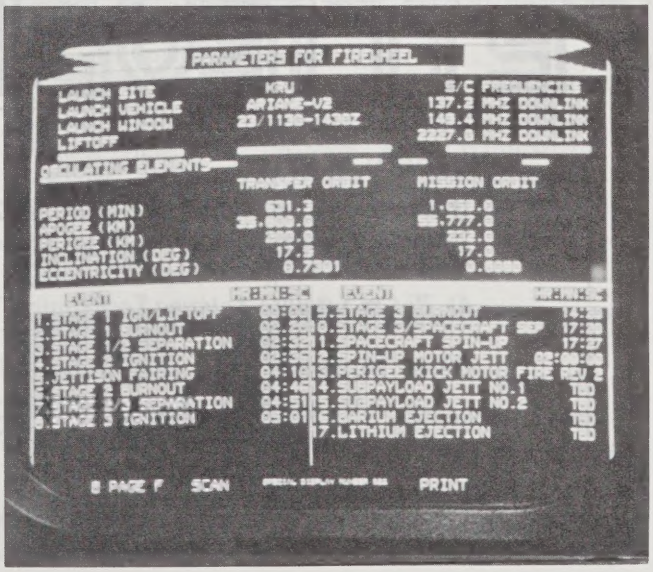
And **HENRY RADIO** is the place to come for all your equipment needs.

For personal assistance, if Phase III and OSCAR are new to you, write, call or drop in and **Jack Somers, WA6VGS** will be glad to help you. Jack is a Life Member of AMSAT, Project OSCAR Member and Member No. 131 of the Mode-J Club.

Call toll-free 800-421-6631
or locally 213-477-6701
11240 W. Olympic Blvd.
Los Angeles, CA 90064

Comets

Parameters for "Firewheel" and AMSAT's Phase IIIA Satellite launch. See page 5.



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              PARAMETERS FOR FIREWHEEL
LAUNCH SITE          KRU                 S/C FREQUENCIES
LAUNCH VEHICLE       ARIANE-V2           137.2 MHZ DOWNLINK
LAUNCH WINDOW        23/1130-1430Z       148.4 MHZ DOWNLINK
LIFTOFF                                 2227.0 MHZ DOWNLINK
OSCULATING ELEMENTS
                     TRANSFER ORBIT      MISSION ORBIT
PERIOD (MIN)             631.3              1.058.0
APOGEE (KM)           35.800.0             55.777.0
PERIGEE (KM)             200.0                232.0
INCLINATION (DEG)         17.5                 17.0
ECCENTRICITY (DEG)         0.7301                0.0000
EVENT                      HR:MN:SC  EVENT                         HR:MN:SC
1.STAGE 1 IGN/LIFTOFF      00:00 9.STAGE 3 BURNOUT                    14:28
2.STAGE 1 BURNOUT          02.28 10.STAGE 3/SPACECRAFT SEP            17:28
3.STAGE 1/2 SEPARATION     02:32 11.SPACECRAFT SPIN-UP                17:27
4.STAGE 2 IGNITION         02:36 12.SPIN-UP MOTOR JETT             02:00:00
5.JETTISON FAIRING         04:10 13.PERIGEE KICK MOTOR FIRE REV 2
6.STAGE 2 BURNOUT          04:46 14.SUBPAYLOAD JETT NO.1                TBD
7.STAGE 2/3 SEPARATION     04:51 15.SUBPAYLOAD JETT NO.2                TBD
8.STAGE 3 IGNITION         05:01 16.BARIUM EJECTION                     TBD
                                 17.LITHIUM EJECTION                    TBD

   B PAGE F    SCAN                                PRINT
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THE AMSAT-GOLEM 80 PROJECT

Hardware

Boards	$45.00
Kits	$245.00
Assembled and Tested	$349.00

AMS80 Software

Documentation (178 pages)	$15.00
Source code 8" CP/M* disc	$30.00
Source code 5" Northstar* (CP/M*)	$30.00
Object Code 5" Northstar*	$10.00

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Comets

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Spectrum International	Cover III

Our Cover: The month of May was quite eventful for AMSAT. Although the Ariane launch vehicle malfunctioned (see page 5) the AMSAT team in Kourou gained valuable experience.

Space Age Ham Radio Magazine

Orbit

Yes, we need your help:
To support the building and operation of satellites.
To develop new satellites for the future.
To disseminate the satellite information you need.
To provide Amateur Radio with its only frontier.
Every member has a duty to show his copy of ORBIT to a non-member of AMSAT and enlist his support.

AMSAT, P. O. Box 27, Washington, DC 20044

Yes, I want to be a member of the AMSAT team. Dues are $16 per year, $200 for Life Membership. Please fill out the form below and mail today.

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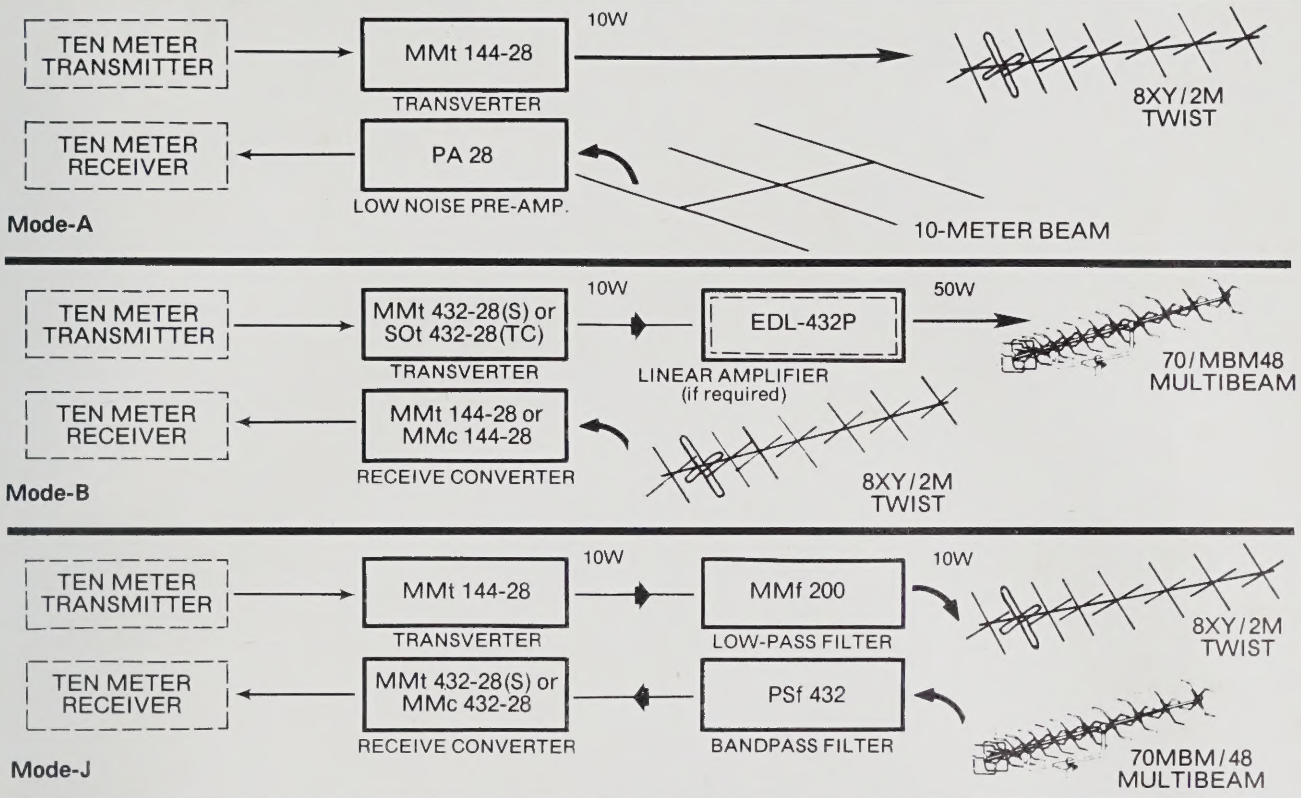
payload retrieval

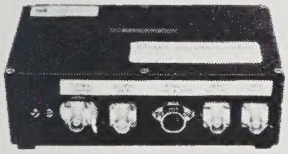
Your vote will determine the *Best of the Issue* award to one of the authors listed below. The award is worth $50 to each author. Vote for your choice in the technical and general interest categories. Each article voted *Best of the Issue* will be eligible to compete for a major piece of equipment as the *Best of the Year.* Mail your ballot to Payload Retrieval, *ORBIT* Magazine, Box 27, Washington, DC 20044, to arrive no later than Sept. 1, 1980.

ORBIT Number 1 — March 1980	*Best Technical*	*Best General Interest*
1) *The AMSAT Phase III Satellite,* G3ZCZ	______	______
2) *Radio Transmissions from Outer Space,* ZS1BI	______	______
3) *It's All in a Night's Work,* WA2LQQ	______	______
4) *70-Cm Satellite Antenna Techniques,* WD4FAB	______	______
ORBIT Number 2 — June/July 1980		
1) *The AMSAT Phase III Satellite,* G3ZCZ	______	______
2) *Ariane Launch Vehicle Malfunctions,* W3IWI and G3ZCZ	______	______
3) *Satellite DX and Propagation,* G3IOR	______	______
4) *Mode-A Converter for 432,* W6XN	______	______

OSCAR SYSTEMS FROM SPECTRUM INTERNATIONAL



CONVERTERS AND TRANSVERTERS FOR



OSCAR 7
OSCAR 8
PHASE III

Specifications:

Output Power: 10W.	Receiver Gain: 30 dB typ.
Receiver N.F.: 3 dB typ.	Prime Power: 12 Vdc

Receive Converters:

MMc 144	$59.95
MMc 432-28(s)	$89.95
MMc 432-28(TC)	$84.95

UHF Filters:

MMf 200-5	$31.95
MMf 200-7	$42.95
PSf 432	$59.95

Receive Preamplifier:

PA-28 $35.95

Mod. kit to adapt original MMt 432-28 FOR Mode-J operation: $26.50

Transverters by Microwave Modules and other manufacturers can convert your existing low-band rig to operate on the VHF and UHF bands. Models also available for 2M to 70 Cm and for ATV operators from Ch2/Ch3 to 70 Cm. Each transverter contains both a Tx up-converter and an Rx down-converter. Write for details of the largest selection available.

Attention owners of the original MMt 432-28 models: Update your transverter to operate OSCAR 8 and Phase III by adding the 434 to 436 MHz range. Mod. kit including full instructions is $26.50 plus $1.50 shipping.

ANTENNAS

2-Meter 8 + 8 Twist Model 8XY/2M	$57.75
Phasing Harness Model PMH/2C	$12.35
48 el. 70 Cm Multibeam Model 70-MBM-48	$69.95
88 el. 70 Cm Multibeam Model 70-MBM-88	$95.95

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Lunar's transverter modules put you here!

Adding various combinations of Lunar's transverter modules to your present station greatly expands your capabilities to: work an Oscar including Phase III; receive noise from the sun for solar flare investigation or for plotting galactic noise sources; receive weather satellite transmission ; or practically anything else found on HF through UHF.

Our transverter modules are distinctly different from the usual transverter or the home built transverter module. With the single band transverter you must purchase a different unit for each additional band you wish to cover.

Lunar's transverter modules, on the other hand, start with the basic down converter for receive and up converter for transmit. Selecting an appropriate local oscillator module determines the band. Additional modules are added to achieve desired receiving NF and/or output power. Changing the local oscillator module changes the band. Pre amps you already have or might build may be used as desired, similarly, for the transmit side.

It's easier than building your own modules from scratch, and costs much less than buying a complete transverter for each additional band.

Some examples of expected performance using Lunar modules.

EXAMPLE 1

Selected modules:
DC 28
LO 28/144
UC-VHF
PAD 144
PAM 144

This combination gives you:
RF: 144 to 146MHz
IF: 28MHz to 30MHz
Conversion Gain: 25dB
Overall NF: 2 dB nom. 1.6 dB typical
Image Rejection: –30 dB typical
LO Purity: –50 dB max. all spurs & harmonics
Drive 28MHz: 1 to 5 mW
Power Output: 20 watts min.
Operating Voltage: 24VDC @ 2.5 amps. nom.

EXAMPLE 2

Modules added to Ex. 1
LO 28/220/222
PAM 220
PAD 220

This gives you:
RF: 220-222, 222-224MHz
Conversion Gain: 22 dB
Overall NF: 2.5 dB typ., 2.2 nom.
Other specs. remain the same.

If you have a specific band you'd like to cover, write or call us and we'll be happy to discuss it with you. Or send for our literature on transverter modules.

LUNAR electronics®

2785 Kurtz Street #10
San Diego, CA 92110
(714) 299-9740 TELEX: 181 747

Louis N. Anciaux
WB6NMT